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CRUISE REPORT[1]

VESSEL: *Oscar Elton Sette*, Cruise 04-02 (OES-011)

CRUISE PERIOD: February 3 - February 26, 2004

AREA OF OPERATION: Territory of American Samoa (Fig. 1)

ITINERARY:

29 Jan — *Oscar Elton Sette* arrived at Pago Pago Harbor, Tutuila, American Samoa to complete OES-04-01. Continued work to create replacement for the Tethered Optical Assessment Device (TOAD) lost on OES-04-01.

30 Jan — Launched Coral Reef Ecosystem Division (CRED) Research Vessel *AHI* (Acoustic Habitat Investigator). Joyce Miller of the Habitat Mapping Team and CDR Ken Barton of the *Oscar Elton Sette* were interviewed by a local television station about upcoming cruise. Disembarked Ed DeMartini, Alan Friedlander, Jason Phillabotte, Brian Zgliczynski, Beth Flint. Embarked Russell Brainard, Sun He Bak, Robert Schroeder, Terry Donaldson, and Craig Musberger. Continued work to create replacement for the TOAD lost on OES-04-01.

31 Jan — Conducted meeting of scientific party and Operations Officer for OES-04-02 to prepare for cruise. Fish team conducted training dive to work on rapid ecological assessment (REA) survey protocols. Continued work to create replacement for the TOAD. Disembarked Jamie Gove.

[1] PIFSC Cruise Report CR-05-008
Issued 2 December 2005

01 Feb — Conducted 4-hour operational test of *AHI* to prepare for transit to Manua Islands. Conducted meeting of fish and benthic REA teams to determine survey stations for cruise. Continued work to create replacement for TOAD. Disembarked June Firing.

02 Feb — Conducted shipboard orientation for new scientists and dive safety management meeting and drill for all scientists. Chief Scientist Russell Brainard gave a presentation about the cruise to about 30 mayors of the villages of American Samoa to familiarize them with our objectives and upcoming activities. Meeting was arranged by Fatima Sauafea of the Pacific Islands Regional Office and Ray Tulafono, Chief of the American Samoa Department of Marine and Wildlfe Resources (DMWR). This meeting was also attended by CDR Ken Barton, Joyce Miller, and Bruce Appelgate. Rusty Brainard and Ray Tulafono were interviewed by the local television station. Rusty Brainard, Joyce Miller, and Bruce Appelgate participated in an American Samoa geographic information systems (GIS) meeting to discuss cruise activities. Rusty Brainard participated in planning meetings with Peter Craig of the National Park Service, Chris Hawkins of the AS Department of Commerce, and Doug Fenner of DMWR. Purchased six drums of gasoline for small boats. Embarked Jean Kenyon, Ron Hoeke, and Megan Moews.

03 Feb — Met with Representative Wallace Thompson of Swains Island. Cast off R/V *AHI* with Scott Ferguson and Joyce Miller. Departed Pago Pago Harbor, Tutuila, American Samoa at 0940 with the following scientific staff on board: Russell Brainard, Robert Schroeder, Joe Laughlin, Kim Page, Ronald Hoeke, Molly Timmers, Jean Kenyon, Jeremey Jones, Megan Moews, Christy Kistner, Terry Donaldson, Sun He Bak, John Rooney, Craig Musberger, Scott Godwin, Jim Maragos, Nancy Daschbach, and Penekosova Peau en route to Manua Islands with R/V *AHI* in escort. Conducted shipboard orientation briefing, fire and emergency drill, abandon ship drill, dive safety management drill, and recompression chamber exercise. Deployed satellite-tracked drifter SVP #44769 at mid-point between Tutuila and Ofu at position 14˚15.065’S, 170˚06.649’W. Arrived at Ofu Island at 1630. *AHI* safely moored alongside pier. Conducted nighttime operations consisting of four TOAD drop camera surveys with the newly rebuilt camera system. All systems worked well. Conducted one deepwater conductivity-temperature-depth CTD to 500 m. CTD winch failed to stop properly during upcast. Conducted three acoustic Doppler current profiler (ADCP) transects.

04 Feb — Conducted 6 towed-diver habitat and fish surveys, 3 fish and benthic REA surveys, and 23 shallow water CTDs around Tau Island. All surveys went from northeast to southwest along the south coast.

Deployed subsurface temperature recorder #1151 in 6.1 m of water on the south side of Tau at position 14˚15.0475'S, 169˚26.8015'W. Mooring team met with village chief at Tau to get approval to deploy sea surface temperature (SST) buoy. Conducted tests of CTD winch. Conducted four TOAD drop camera surveys and four ADCP transects around Manua Islands.

05 Feb — Conducted 6 towed-diver habitat and fish surveys, 3 fish and benthic REA surveys, and 14 shallow water CTDs around the northern half of Tau Island. Deployed SST buoy #306-025 in 13.7 m of water on the west side of Tau just south of Tau Village harbor at position 14˚14.6229'S, 169˚30.5662'W and subsurface temperature recorder (STR) #1152 in 10.1 m of water near large coral bommies at east end of Tau at position 14˚14.1268'S, 169˚25.1446'W. Conducted two deepwater CTDs, three TOAD drop camera surveys, and four ADCP transects.

06 Feb — Conducted 6 towed-diver habitat and fish surveys, 3 fish and benthic REA surveys, and 20 shallow water CTDs around the southeastern half of Olesega and Ofu Islands and within the shallow pools of Ofu Lagoon. Deployed STR#1149 in 9.8 m of water at the REA monitoring site off Olesega Village at position 14˚10.9052'S, 169˚37.5972'W. Conducted one shipboard CTD and three ADCP transects. Conducted four TOAD drop camera surveys. Deployed satellite-tracked SVP drifter #44765 between Olesega and Tau at position 14˚18.315'S, 169˚32.656'W.

07 Feb — Conducted 6towed-diver habitat and fish surveys, 3 fish and benthic REA surveys, and 25 shallow water CTDs around the northwestern half of Olesega and Ofu Islands. Deployed STR#1148 in 6.4 m of water on the northwest side of Olesega near the REA monitoring site off Sili Village at position 14˚09.8358'S, 169˚37.4920'W. Deployed STR#1150 in 6.1 m of water on the west side of Ofu near the REA monitoring site off Ofu Village at position 14˚10.4174'S, 169˚40.8990'W. Conducted three TOAD drop camera surveys. Departed Manua Islands at 2230 en route to Rose Atoll.

08 Feb — Arrived Rose Atoll at 0730. Conducted six towed-diver habitat and fish surveys around entire atoll at mid-depths. Conducted three fish and benthic REA surveys on northeast and southeast facing forereef slopes. Retrieved 2002 CREWS buoy #262-005 (Argos ID 10214) and deployed new CREWS buoy #262-004 (Argos ID 27267) at same position 14˚33.0840'S, 168˚09.6110'W. Conducted one shallow water CTD. Shipboard ADCP system and CTD winch failed. After troubleshooting, ADCP was apparently repaired around 2300. Conducted four ADCP transects around Rose Atoll. Water depths too deep to allow TOAD camera surveys. Deployed satellite tracked drifter SVP#44767 east of Rose Atoll at position 14˚34.415'S, 168˚12.559'W.

09 Feb — Conducted six towed-diver habitat and fish surveys around entire atoll at deep (20-25 m) and shallow (5-10 m) depths. Conducted three fish and benthic REA surveys on southeast and southwest facing forereef slopes. Retrieved Aanderaa RCM9 current meter #417 deployed in 3.4 m of water in the sill of the high velocity pass into Rose Atoll at position 14˚32.1110'S, 168˚09.2890'W. Conducted 22 shallow water CTDs. Conducted 5 shipboard CTDs and 12 ADCP transects around atoll.

10 Feb — Conducted six towed-diver habitat and fish surveys around deep (20-25 m) northwest and southwest reef slopes, the lagoon interior, and backreefs. Conducted three fish and benthic REA surveys on southwest facing forereef slopes near the shipwreck site. Deployed STR#1047 in 3.4 m of water on coral pinnacle next to CREWS buoy at position 14˚33.0775'S, 168˚09.6114'W. Deployed STR#1146 in 7.9 m of water on same coral pinnacle next to CREWS buoy at position 14˚33.0753'S, 168˚09.6116'W. Conducted 21 shallow water CTDs, 4 shipboard CTDs, and 8 ADCP transects around atoll.

11 Feb — Conducted four towed-diver habitat and fish surveys around deep (20-25 m) east and north reef slopes, the lagoon backreefs. Conducted three fish and benthic REA surveys on northwest facing forereef slope and two lagoon pinnacle reefs. Deployed STR#1147 in 7.9 m of water on engine block of wrecked longliner at REA monitoring site at position 14˚33.0407'S, 168˚10.0195'W. Deployed wave and tide recorder (WTR)#0364 in 17.1 m of water on the east reef terrace at position 14˚32.8660'S, 168˚08.2564'W. Conducted three shipboard CTDs around atoll. Deployed STR#1145 in 2.4 m of water at REA monitoring site on pinnacle just inside pass at position 14˚32.2675'S, 168˚09.2050'W. ADCP failure prevented current profiler transects. Departed Rose Atoll at 2230 en route to Tau Island.

12 Feb — Arrived at Tau Island at 0730. Conducted six towed-diver habitat and fish surveys around deep (20-25 m) and shallow (5-10 m) north and west reef slopes. Conducted three fish and benthic REA surveys on the north, northwest, and west forereef slopes off Tau Villages. Conducted two test radiometry casts of the Biospherical multichannel radiometer. Conducted five TOAD drop camera surveys and three shipboard CTDs.

13 Feb — Conducted six towed-diver habitat and fish surveys around deep (20-25 m) and shallow (5-10 m) east and south reef slopes of Olesega and Ofu Islands. Conducted three fish and benthic REA surveys off east Olesega, and south and west Ofu. Conducted shallow water biospherical radiometer casts off Ofu Island. Conducted shallow water CTD transect in Ofu Lagoon. Conducted five TOAD drop camera surveys and two shipboard CTDs off Olesega and Ofu Islands.

14 Feb	R/V *AHI* arrived alongside at 0630 to transfer personnel and equipment. Embarked scientist Lara Hansen of the World Wildlife Fund at 0645 and departed Manua Islands en route to Tutuila. Arrived off Tutuila at 1230 and disembarked scientists Daschbach and Hansen via small boat. Embarked scientist Stephani Holzwarth and departed for Swains Island at 1345.
15 Feb	Arrived at Swains Island at 1200. Conducted four towed-diver habitat/fish surveys around northwest, north, northeast, and southeast forereefs. Conducted two fish and benthic REA surveys. Conducted one shallow water CTD. Conducted six bioacoustic transects and four shipboard CTDs.
16 Feb	Conducted six towed-diver habitat/fish surveys around Swains Island. Conducted three fish and benthic REA surveys. Recovered Ocean Data Platform (ODP) #267-001. Deployed STR#1142 at former ODP anchor in 14 m of water at position 11˚03.5130'S, 171˚05.4550'W. Conducted 16 shallow water CTDs and several radiometry casts. Ship's crew and some scientific staff visited Swains Island. Conducted seven bioacoustic transects and four shipboard CTDs. Deployed satellite-tracked SVP drifter #29109 at position 11˚05.729'S, 171˚05.512'W.
17 Feb	Conducted four towed-diver habitat/fish surveys and two drop dive habitat/fish surveys around Swains Island. Conducted three fish and benthic REA surveys on western forereef. Conducted one invertebrate and algae survey of the shallow backreef. Conducted 12 shallow water CTDs in Swains Lake and around lagoon. Conducted CTD tow in shallow lagoon. USPHS Medical Officer diagnosed patient from Swains Island needing a medical evacuation. Embarked patient Rapeti Ogevai and her 1-year-old daughter from Swains Island for medical evacuation to Pago Pago at 1745 and immediately departed Swains Island en route to Pago Pago.
18 Feb	Arrived at Pago Pago at 1400 to disembark patient Ogevai and her daughter. Launched three REA boats at 1445. Embarked scientist Fatima Sauafea. Departed Pago Pago Harbor at 1520. Conducted one towed-diver habitat/fish survey and one fish and benthic REA survey over Taema Bank. Conducted six TOAD drop camera surveys along southern bank of Tutuila, one shipboard CTD, and four bioacoustic transects.
19 Feb	Conducted six towed-diver habitat/fish surveys around Aunuu Island and east end of Tutuila. Conducted three fish and benthic REA surveys off Aunuu and the northeast side of Tutuila. Retrieved Aunuu SST buoy #268-002 (Argos ID23494) and redeployed SST buoy #306-022 (Argos ID30585) in 7.6 m of water at the same position 14˚17.0229'S, 170˚33.7357'W. Conducted 20 shallow water CTDs and 8 radiometry casts. Conducted six TOAD drop camera surveys of east and northeast

bank of Tutuila. Conducted one shipboard CTD and three bioacoustic transects.

20 Feb — Conducted six towed-diver habitat/fish surveys along northeast coast of Tutuila. Conducted three fish and benthic REA surveys along northeast and north coast of Tutuila. Conducted 19 shallow water CTDs and 4 radiometry casts. Deployed STR#1143 at REA site Tut-5 in Masafau Bay in 5.8 m of water at position 14˚15.1163'S, 170˚37.4250'W. Conducted seven TOAD drop camera surveys of east and northeast bank of Tutuila. Conducted one shipboard CTD. Conducted three bioacoustic transects.

21 Feb — Conducted six towed-diver habitat/fish surveys along north coast of Tutuila. Conducted three fish and benthic REA surveys along north coast of Tutuila. Large long period swell (16 sec) resulted in high surge and low visibility. Conducted 20 shallow water CTDs and five radiometry casts. Deployed SST buoy #306-023 (Argos ID30595) in 8.2 m of water in Fagasa Bay at position 14˚17.0615'S, 170˚43.3471'W to replace SST buoy #268-001 (Argos ID23489), which broke its mooring and washed ashore during Hurricane Heta on January 5, 2004. Conducted seven TOAD drop camera surveys of north, northwest, and southwest banks of Tutuila. Conducted one shipboard CTD and three bioacoustic transects.

22 Feb — Conducted six towed-diver habitat/fish surveys along southeast coast of Tutuila. Conducted three fish and benthic REA surveys along southeast coast of Tutuila. Conducted 25 shallow water CTDs and 9 radiometry casts. Conducted five TOAD drop camera surveys of south bank of Tutuila. Conducted one shipboard CTD and five bioacoustic transects.

23 Feb — Conducted six towed-diver habitat/fish surveys along south coast of Tutuila from Pago Pago to Larsen's Bay. Conducted three fish and benthic REA surveys along southeast coast of Tutuila. Conducted 31 shallow water CTDs, 1 lagoon CTD tow. Deployed STR#1141 in 1.2 m in lagoon off airport at position 14˚19.8301'S, 170˚42.1544'W. Conducted five TOAD drop camera surveys of south bank of Tutuila. Conducted one shipboard CTD. Conducted one bioacoustic transect.

24 Feb — Conducted six towed-diver habitat/fish surveys along southwest coast of Tutuila from Step's Point to Point Taputapu. Conducted three fish and benthic REA surveys at Larsen's Bay, Fagatele Bay, and Leone Bay along south coast of Tutuila. Recovered Aanderaa RCM9 current meter #415 deployed in 2002 off Step's Point at position 14˚22.4960'S, 170˚45.4993'W. Deployed Wave and Tide Recorder (WTR) #0385 in 22 m of water at same position. Deployed two subsurface temperature recorders (STR #1144) in 20.1 m of water at position 14˚21.8706'S, 170˚45.7557'W and STR#1371 in 6.7 m of water at position 14˚21.8413'S, 170˚45.7197'W in Fagatele Bay National Marine

Sanctuary. Conducted seven TOAD drop camera surveys of south bank of Tutuila. Conducted one shipboard CTD and five bioacoustic transects. Deployed SVP drifter #29110 at position 14˚19.518'S, 170˚58.016'W.

25 Feb — Conducted six towed-diver habitat/fish surveys along northwest coast of Tutuila, including one offshore reef. Conducted three fish and benthic REA surveys along west and northwest coast of Tutuila. Deployed SST buoy #306-024 (Argos ID30611) in 22 m of water at position 14˚19.6940'S, 170˚50.0010'W in Amanave Bay to replace SST Buoy #268-004, which broke from it's mooring during Hurricane Heta on January 5, 2004. Conducted 12 shallow water CTDs. Conducted five TOAD drop camera surveys of south bank of Tutuila and one shipboard CTD. Conducted one bioacoustic time series station. Deployed SVP drifter #44770 at position 14˚31.186'S, 170˚42.090'W.

26 Feb — Arrived Pago Pago, Tutuila at 1015 to complete cruise. Refueled ship. Disembarked Miller.

27 Feb — Off-loaded CRED container, boat rack, 19-ft SAFE boat, 55-gal fuel drums and racks, and ship's fuel drums for storage during OES-04-03. Conducted interview with local television station and Fatima Sauafea. Chief Scientist Brainard met with Ray Tulafono, Chief of the American Samoa Department of Marine and Wildlife Resources to discuss preliminary cruise results. Brainard and Schroeder met with Peter Craig, Chris Hawkins, Nancy Daschbach, Fatima Sauafea, and ~10 other members of the American Samoa Coral Reef Advisory Group to discuss the cruise. Disembarked Donaldson, Kenyon, Maragos, Jones, Bak, Laughlin, Kistner, and Moews.

28 Feb — Disembarked Brainard.

29 Feb — Disembarked Holzwarth, Hoeke, Page, Timmers, and Godwin.

MISSIONS AND RESULTS:

See Appendices

Summary Statistics:

Towed Diver Habitat/fish Surveys – 115 tows, ~231 km
- Ta'u Island – 18 tows, ~39 km
- Olesega Island – 9 tows, ~20 km
- Ofu Island- 9 tows, ~20 km
- Rose Atoll – 22 tows, ~45 km
- Swains Island – 14 tows, ~26 km

Aunuu Island – 4 tows, ~7 km
Tutuila Island – 39 tows, ~74 km

Fish and Benthic REA Surveys - 63
Ta'u Island - 9
Olesega Island - 4
Ofu Island- 4
Rose Atoll - 14
Swains Island - 10
Aunuu Island - 1
Tutuila Island – 21

CREWS buoy recovery and deployment – 1
Rose Atoll - 1

Ocean Data Platform deployments - 2
Swains Island recovery - 1

SST buoy deployments - 4
Ta'u Island -1
Aunuu Island - 1
Tutuila Island - 2
Fagasa Bay - 1
Amanave Bay - 1

Aanderaa RCM9 Current Meter recoveries – 2
Rose Atoll Pass – 1
Step's Point, Tutuila - 1

Subsurface Temperature Recorder deployments - ?
Ta'u Island – 2
Ofu Island – ?
Olesega Island – ?
Rose Atoll - ?
Tutuila Island – 4
Fagatele Bay NMS – 2
Airport Lagoon – 1
Masefau Bay – 1
Swains Island - ?

SVP satellite-tracked drifter deployments – 6
Settlement/recruitment plate recoveries/deployments – 2
arrays
Shipboard CTDs to 500 m - 36
Shallow water CTDs -
TOAD drop camera surveys - 76

QTC acoustic habitat classification surveys - ? km
Shipboard ADCP/TSG transects – 38 (Note- ADCP failure 2/11)

RECORDS:

The following forms, logs, charts, and data records were kept and given to the Pacific Islands Fisheries Science Center upon termination of the cruise. These include all data captured onto computer storage media during the cruise. All the records are filed there unless indicated otherwise in parentheses.

QTC acoustic seabed classification data
TOAD digital video tapes (VHS & MDV)
ArcView GIS track files and shape files
ADCP DOPPLER ping data files on CD-ROM*
CTD Station Data Log Sheet
Seabird CTD data files on CD-ROM*
Digital camera photos (JPG file format) on CD-ROM*
Marine Operations Log
Project Area and Operations Chartlets
Scientist's Log
SCS data files (raw & compressed) on CD-ROM*
Station Number and Activity Log

*All data files together on the same (1) CD-ROM

SCIENTIFIC PERSONNEL:

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Terry Donaldson, Ph.D., Reef Fish Biologist, fish team, University of Guam Marine Laboratory
Craig Musberger, Fishery Biologist, fish team, UH-JIMAR and PIFSC-CRED
Jean Kenyon, Ph.D., Marine Ecologist, benthic team coral specialist, UH-JIMAR and PIFSC-CRED
Kim Page, Marine Debris Specialist, benthic team algae specialist, UH-JIMAR and PIFSC-CRED
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Scott Godwin, Invertebrate Specialist, benthic team invertebrate specialist, Bishop Museum
James Maragos, Ph.D., Coral Biologist, benthic team coral specialist, US Fish and Wildlife Service (USFWS)

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Lara Hansen, visiting scientist, World Wildlife Fund

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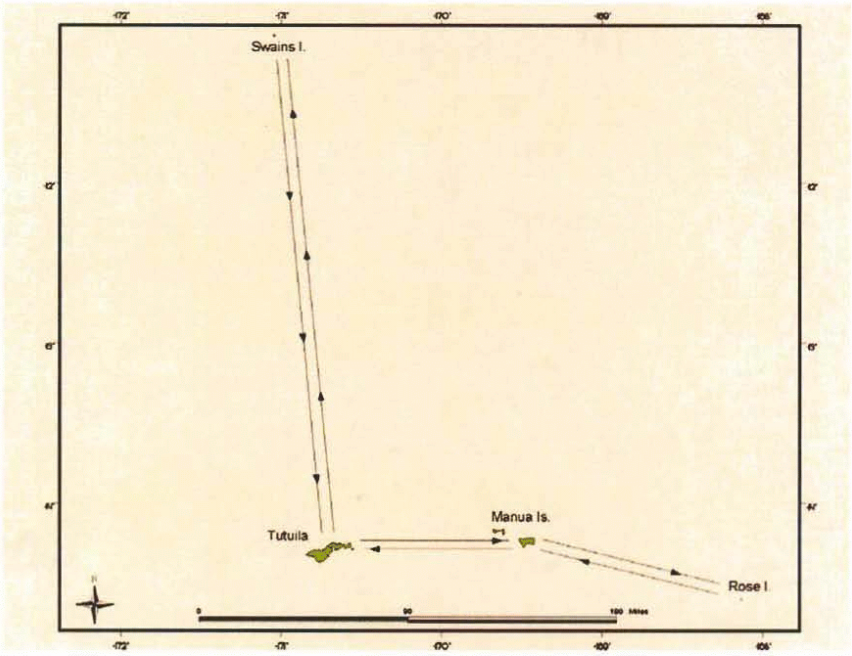

Figure 1.--Track of the NOAA Ship Oscar Elton Sette OES-04-02 (OES-11), February 3-26, 2004.

Appendix A: **Fish Rapid Ecological Assessment (REA) Team Activity Report** (*Robert Schroeder, Terry Donaldson and Craig Musburger*)

Manua Islands, Rose Atoll
From 4 to 13 February 2004, the fish census team surveyed 30 stations— 9 at Tau, 9 at Ofu/Olosega, and 12 (plus 2 collecting dives) at Rose Atoll. Quantitative belt transects (BLT), stationary point counts (SPC), and qualitative REA surveys were conducted at each of these sites, following the same methodology as described in the first report.

Fish transect stations consisted of three consecutive 25-m lines set along a single depth contour at 13–15 m. As each line was set, the observers swam about 5 m apart along either side along each side of the line, counting and recording size classes for all fishes >20 cm total length (TL) within an area 4 m wide and 4 m high. At the end of each 25-m line, the divers turned around and, while remaining on either side of the line, began counting and recording size classes of all fishes within 2 m of their side of the line and 4 m off the bottom. Four stationary point counts were made at each transect station, generally ~15 m from the transect line. SPCs consist of the diver counting and recording the size classes for all fishes >25-cm total length observed in a cylindrical volume 10 m in radius during a 5-minute period. In addition, the divers recorded the species of fishes seen outside the transect area and outside the SPC counts on an opportunistic basis. During REA surveys, the divers record all species observed during the dive. These observations of the diversity are combined with fish observed by other divers (benthic team, tow team, or mooring team) to develop an island-wide listing of all fishes observed.

At Tau, three sites were "monitoring stations" (established in 2002) and six were new stations. At Ofu/Olosega, five sites were monitoring stations and four were new. At Rose, eight sites were monitoring stations and four were new. New stations were selected based on sides of the island not previously sampled, reference to priority monitoring sites in "The American Samoa Coral Reef Monitoring Program," and previous surveys conducted in recent year (i.e., A. Green).

In general, sharks, large predators, and other large (>30 cm TL) fish appeared to be rare at reefs around these islands and atoll. Our subjective impression (pending statistical confirmation) was that large fish were somewhat fewer than in CRED's 2002 surveys.

The total number of coral reef fish species CRED documented in 2002 for each of the islands was 127 for Tau, 168 for Ofu/Olosega, and 222 for Rose Atoll. The total number of species we observed in 2004 was 227 at Tau, 271 at Ofu/Olosega, and 272 at Rose Atoll. The higher figures from 2004 reflect (in part) greater sampling effort (i.e., about twice the number of man-dives). Again, Rose exhibited higher diversity as it has the most diverse habitat types. Considering common reef fish families, these islands were similar with wrasses ranking as the most speciose (36-42 spp/island), followed by surgeonfish (26-31), damselfish (18-22), and parrotfish (6-11).

No bumphead parrotfish (*Bolbometopon muricatum*) were sighted, and only several _ humphead wrasse (*Cheilinus undulatus*) were observed, mostly small ones.

Efforts to collect specimens were applied at two stations within the lagoon at Rose Atoll. Target species included *Dascyllus auripinnis* and *Cirrhilabrus katherinae.* The former species was not observed at any of the sites at Rose Atoll, but was reported as rare in the lagoon by the fish towboard team. Four specimens of the latter species were taken with hand net.

Fish Family Summaries

Damselfish (Pomacentridae) were by far the most abundant family by number, with one species in particular, the midget chromis (*Chromis acares*), especially dominant. Diversity within this family was relatively low. It was not unusual to observe fewer than seven damselfish species at a given site. While all islands supported high densities of damselfish, they were especially dominant at Rose Atoll where it was common to observe 100-200 individual midget chromis on a single transect.

Two families, the surgeonfish (Acanthuridae) and the wrasses (Labridae), were common and showed relatively high diversity at all locations. Thirty or more species of surgeonfish were observed at both Rose Atoll and Ofu/Olosega with only slightly fewer at Tau. Several species of bristletooth surgeons (*Ctenochaetus spp.*) and the orangespine unicornfish *(Naso lituratus*) were most common, but no single species dominated the surgeonfish species composition at any site. Among wrasses, the bird wrasse (*Gomphosus varius*), the ornate wrasse (*Halichoeres ornatissimus*), and the sunset wrasse (*Thalassoma lutescens*) were common, but again no single species dominated this very diverse family. One notable exception would be the inside of the lagoon at Rose Atoll which was heavily dominated by the threespot wrasse (*Halichoeres trimaculatus)* which was rare or absent from most other locations surveyed.

Among larger fish (>20cm), groupers (Serranidae), snappers (Lutjanidae), and parrotfish (Scaridae) were most common. Groupers were largely dominated by the peacock grouper (*Cephalopholis argus*) which seemed to be the most common species among all large fish. The most common snappers were the smalltooth jobfish (*Aphareus furca*), twinspot snapper (*Lutjanus bohar*), and blue-lined snapper (*L. kasmira*). Parrotfish showed considerably higher diversity with several species including rainbow (*Scarus forsteni*), redlip (*S. rubroviolaceus*), bridled (*S. frenatus*), dark-capped (*S. oviceps*), bullethead (*Chlororus sordidus*), pacific steephead (*C. microrhinos*), and tan-faced (*C. frontalis*) parrotfish contributing to the family's abundance. Also common among larger fish were the orangespine unicornfish (*Naso lituratus*), the bigeye emperor (*Monotaxis grandoculis*), and the pinktail (*Melichthys vidua*) and black (*M. niger*) triggerfishes.

One family which showed extremely low abundance and diversity was the jack family (Carangidae). Very few, if any, jacks were observed on belt-transects at each site. When present, the most common species was the bluefin trevally (*Caranx melampygus*). Infrequent sightings were made of rainbow runners (*Elagatis bipinnulata*) and black

jacks (*Caranx lugubris*). One large school of bigeye trevally (*C. sexfasciatus*) was observed by the tow team southwest of the channel at Rose Atoll, but the fish REA team observed no such occurrences.

Herbivorous fishes (e.g., large schools of *Naso lituratus, Acanthurus triostegus,* and *Ctenochaetus striatus*) were common at Rose. At the site of the 1993 longliner grounding (the central SW side), high densities of herbivores (surgeonfish, parrotfish, and pygmy angelfish) continued to dominate. Heavy cover by cyanobacteria and related blue-green "algae," in response to iron-enrichment from corroding wreckage, was visible at this outer reef slope station (ROS-7) in contrast to other "reference" sites (hundreds of meters away) surveyed along this arm (ROS-4, -5, -# [=SW3]) and stations elsewhere around the atoll. Pieces of wreckage were still visible around the transect area.

Notes on Rare Species, Alternate Color-morphs, and Range Extensions

Note: localities are given in parentheses unless otherwise indicated.

The following groupers (Serranidae) were observed: *Anyperodon leucogrammicus* (Ofu/Olosega), *Cephalopholis sonnerati* (Rose Atoll, lagoon) and *Epinephelus macrospilos* (Tau; rare).

The soapfish, *Grammistes sexlineatus* (Serranidae), was observed at Ofu/Olosega and is presumed to be cryptic or rare (mainly because this species emerges from holes on reefs during daylight and so can be seen).

The following butterflyfishes (Chaetodontidae) were observed: *Chaetodon melannotus* (Tau), *Chaetodon plebius* (Ofu/Olosega), *Chaetodon punctatofasciatus* (Tau), *Chaetodon rafflesii* (Ofu/Olosega), *Chaetodon semion* (Ofu/Olosega), and *Heniochus monoceros* (Tau).

Herald's angelfish, *Centropyge heraldi* (Pomacanthidae), was observed at Ofu/Olosega. The flame angelfish, *Centropyge loriculus*, was observed at Ofu/Olesega, Tau, and Rose Atolls.

The smalltail wrasse, *Pseudojuloides cerasinus* (Labridae), was observed at Ofu/Olosega.

Moyer's dragonet, *Synchiropus moyeri*, thought to be endemic to marginal areas along the boundary of the Pacific and Philippine plates, was observed at Tau. A congener, Morrison's dragonet, *Synchiropus morrisoni*, was observed at Ofu/Olosega.

The singlespine surgeonfish, *Naso thynnoides* (Acanthuridae), was observed at Rose Atoll. This species is known only from the Indian Ocean east to southern Japan and Papua New Guinea.

The blackbelly Picasso fish, *Rhinecanthus verracosa* (Balistidae) was observed twice at Ofu/Olosega. This species is known only from the Indian Ocean east to the Solomon

Islands, Great Barrier Reef (Australia), Vanuatu, and southern Japan; this sighting represents a considerable range extension.

Diminutive species of both blennies (Blenniidae) and gobies (Gobiidae) were observed and included the following species: *Blenniella paula* (Blenniidae; Rose Atoll), *Ecsenius bicolor* (Blenniidae; Tau and Ofu/Olosega), *Ecsenius opsifrontalis* (Blenniidae; Tau), *Eviota guttatus* (Gobiidae; Ofu/Olosega), *Eviota saipanensis* (Gobiidae; Ofu/Olosega and Tau) and *Eviota* sp. (Gobiidae; Tau), *Gobiodon citrinellus* (Gobiidae) in live *Acropora* sp. coral heads (Rose Atoll and Ofu/Olosega); *Trimma* sp. (Gobiidae; Tau), and *Asterropteryx bipunctatus*, *Asterropteryx ensiferus*, *Asterropteryx* sp., *Gnatholepis anjerensis*, *Istigobius decoratus*, and *Macrodontogobius wilburi* (all Gobiidae) in the lagoon at Rose Atoll.

Previously known or expected species that were very rare or absent from localities

Lizardfishes (Synodontidae) were conspicuous by their absence; one unidentified species was observed during a TOAD run off of Ofu, however (depth ca. 60 m; TJD personal observation).

Scorpionfishes (Scorpaenidae) were rarely observed. These fishes are largely cryptic, so this is not surprising; however, they should have been more evident. *Sebastipistes cyanotigma* and *Pterois antennata* were observed at Ofu/Olosega and Rose Atoll, respectively.

The blacktip grouper, *Epinephelus fasciatus* (Serranidae) was rarely seen at all three localities. Normally, this species should be seen commonly.

The flame hawkfish, *Neocirrhites armatus* (Cirrhitidae), was present only at Ofu/Olosega, and rarely at that; this species was not found at Rose Atoll nor at Tau although suitable habitat existed at both localities (see previous data, A. Green's observations, etc.). Apparently, *Pocillopora* spp.have rebounded at Rose Atoll following the last bleaching event. If *N. armatus* was found there previously, it may have been extirpated with the loss of favored corals from bleaching. The spotted coral croucher, *Caracanthus maculatus* (Caracanthidae), found frequently in *Pocillopora eydouxi* coral heads with *N. armatus*, was observed although in low numbers. The yellow-spotted scorpionfish, *Sebastipistes cyanostigma*, (Scorpaenidae), another obligate *Pocillopora* coral-dwelling species, was also absent except for a single record at Ofu/Olosega. The leopard blenny, *Exallias brevis* (Blennidae), yet another obligate coral-dwelling species, was rare at Tau and Ofu/Olosega but apparently absent from Rose Atoll.

Cardinalfishes (Apogonidae) were rare at all three localities. Greatest diversity (n = 6 spp.) was observed in the lagoon at Rose Atoll, however. There, cardinalfishes were found sheltering under coral bommies adjacent to pinnacles.

Three species of butterflyfishes (Chaetodontidae), *Chaetodon kleini*, *C. meyeri*, and *C. trifascialis* reported previously were not observed.

Only the latticed sandperch, *Parapercis clathrata* (Pinguipedidae), was observed on reef pavement, rubble, or coarse sand. Other species of this genus were expected to be seen.

Rabbitfishes (Siganidae) were absent from all localities surveyed.

The longnose surgeonfish, *Zebrasoma rostratum* (Acanthuridae), was present only at Rose Atoll and was very rare.

Sharpnose puffers (genus *Canthigaster*, family Tetraodontidae) were present only at Ofu/Olesega (1 species) and Rose Atoll (four species), but were generally rare at all localities.

Reef Flat Species (Ofu Lagoon)

The following species were seen exclusively on the reef flat (lagoon) at the American Samoa National Marine at Ofu: the spotted pilchard (*Amblygaster sirm*, Clupeidae), the yellow-spotted scorpionfish (*Sebastapistes cyanostigma*, Scorpaenidae), the small-spotted pompano (*Trachinotus bailloni*, Carangidae), the blue trevally *(Carangoides ferdau*, Carangidae), the red-spotted blenny (*Blenniella chrysospilos*, Blennidae), the lined rockskipper, (*Istiblennius lineatus*, Blenniidae), and the jewelled blenny (*Salarias fasciatus*, Blenniidae).

Recruitment pulses:

Manua Islands:

Thalassoma lutescens (Labridae) and *Paracirrhites arcatus* (Cirrhitdae) post-settlement and slightly older juveniles were observed regularly.

Rose Atoll:

Thalassoma lutescens and *Gomphosus varius* (both Labridae), and *Paracirrhites arcatus* (Cirrhitidae) juveniles were observed regularly.

Spawning aggregations

Apparent resident spawning aggregations were observed for the following species at Rose Atoll just prior to, during and after the full moon: the checkerboard wrasse (*Halichoeres hortulanus*, Labridae), the bluehead wrasse (*Thalassoma amblycephalum*, Labridae; also at Tau and Ofu/Olosega), the tan-faced parrotfish (*Chlorurus frontalis*, Scaridae; also at Tau and Ofu/Olosega), the steephead parrotfish (*Chlorurus microrhinos* (Labridae), and the bullethead parrotfish (*Chlorurus sordidus*, Scaridae; also at Tau and Ofu/Olosega).

A presumptive transient spawning aggregation was observed for the following species at Rose Atoll just prior to, during, and just after the full moon: the orangespine unicornfish (*Naso lituratus*, Labridae). Note that adults of a number of surgeonfish species were absent from stations during this time. Most notable was *Acanthurus lineatus* that may have migrated to the pass or to an underwater promontory to spawn. Also, large schools of adult convict tangs, *Acanthurus triostegus* (Acanthuridae), were observed moving along the reef slope after the passing of the full moon; it is possible that these were fishes returning from a spawning aggregation site.

Rose Atoll Reef Front and Spur and Groove Zone

Grouper diversity in the habitats surveyed was quite low but abundances of two or three species were high. *Cephalopholis urodeta* was the most commonly seen species, followed by *C. argus*. Both species had individuals that were relatively large, especially *C. urodeta*, and this was indicative of low fishing pressure. *Cephalopholis spiloparea* tended to occur below 12 m; some of the individuals observed were quite large for this species. Similarly, in the lower spur and groove and bench zones, *Epinephelus hexagonatus* was seen, although less commonly, and those observed were among the largest individuals of this species seen anywhere. *Epinephelus melanostigma*, and to a lesser extent, *E. howlandi*, were also observed although irregularly. *Epinephelus fasciatus* was rare and *Gracila albomarginata* was uncommon. *Cephalopholis leopardus* was observed in holes along the lower bench and is likely common in suitable habitats (reef slopes and walls with numerous holes).

Humphead wrasse (*Cheilinus undulatus*) were seen rarely. Bumphead parrotfish (*Bolbometapon muricatum*) were rare or absent, as well.

Apparently, Rose Atoll suffered considerable coral damage following a coral bleaching event. Regrowth of *Pocillopora* corals meant that favored habitat for hawkfishes was in abundance. *Paracirrhites arcatus* was most common*; Paracirrhites hemistictus* also so. Curiously, *Paracirrhites forsteri* was largely absent. Also, *P. hemistictus polystictus*, the dark morph of *P. hemistictus*, was found down to depths of over 14 m; normally, this species is found only in the spur and groove and the very upper reaches of the first terrace or bench. *Cirrhitus pinnulatus* was found in the lower spur and groove zone but virtually all individuals were less than 20 cm TL. *Neocirrhites armatus* was absent in spite of the availability, now, of suitable habitat. (Check previous reports and relevance to bleaching and loss of microhabitat). *Cirrhitichthys falco*, a species that favors pavement on reef benches, was present, although in low numbers.

Rose Atoll Lagoon

The suite of species observed at pinnacles within the lagoon was, for the most part, consistent with that normally observed on shallow reef flats. A number of species not detected previously on transects outside of the lagoon were observed (see below). One species of grouper, *Cephalopholis sonnerati* (Serranidae), maintained mating groups

consisting of a single male and two females, at larger coral bommies adjacent to the pinnacles (depth = 12-14 m).

Shallow water bommies were often undercut and had a surprising number of species present. These included some larger predators, such as the onespot snapper, *Lutjanus monostigmus* (Lutjanidae), and the peacock grouper, *Cephalopholis argus* (Serranidae).

One large ray (*Himantura uarnack*, Dasyatidae) was observed on an adjacent shallow rubble flat (at the first collecting station, near the instrument buoy mooring site).

The following species were recorded from the lagoon at Rose Atoll but not, or rarely, elsewhere: the reticulate whipray (*Himantura uarnak*, Dasyatidae), the goldspot herring (*Herklotsichthys quadrimaculatus*, Clupeidae), a reef halfbeak *(Hyporhamphus acutus*, Hemirhamphidae), the tomato grouper *(Cephalopholis sonnerati*, Serranidae), the yellow cardinalfish (*Apogon luteus*, Apogonidae), the iridescent cardinalfish (*Apogon kallopterus*, Apogonidae), the fragile cardinalfish *(Apogon fragilis*, Apogonidae), the five-lined cardinalfish (*Cheilodipterus quinquelineatus*, Apogonidae), the graceful cardinalfish (*Rhabdamia gracilis*, Apogonidae), an unidentified cardinalfish resembling *Apogon apogonoides* (Apogonidae), a second unidentified cardinalfish (Apogonidae), Katherine's wrasse (*Cirrhilabrus* "*katherinae*," Labridae), the orange-spotted goby (*Asterropteryx bipunctatus*, Gobiidae), the blue-speckled rubble goby (*Asterropteryx ensiferus*, Gobiidae), an unidentified *Asterropteryx* sp. goby (Gobiidae), the eyebar goby (*Gnatholepis anjerensis*, Gobiidae), the large-tooth goby (*Macrodontogobius wilburi*, Gobiidae), and the yellowmargin triggerfish (*Pseudobalistes flavimarginatus*, Balistidae; also recorded from sandy areas at Tau). A large humphead wrasse, *Cheilinus undulatus* (Labridae), was also observed in the lagoon.

<u>Species with Uncertain Identifications</u>

Several fish species have not been identifiable in the field. We have collected video and still photographic images or specimens for all of the unidentified species which will allow for positive identification upon return to Honolulu. Summarized here are brief descriptions of the questionable species with our suspected identifications included.

Wrasses:

- A small (4-10 cm) elongate wrasse of the genus *Pseudocheilinus* with orange/red spots dorsally and reddish lines ventrally on a white base. Possibly an unusual color morph of *Pseudocheilinus octataenia*.

- A color variant of the fourline wrasse, *Pseudocheilinus tetrataenia,* was found at Rose Atoll; this variant had a distinctive inverted triangle patch, colored royal or purple-blue, beneath the eye extending on to the operculum. This may be a new species.

- A color variant of the striated wrasse, *Pseudocheilinus evanidus*, was observed at Rose Atoll and at Ofu/Olosega. This fish was distinguished by

having red or dark pink spots rather than yellow spots along its flank. This may be an undescribed species.

- An unidentified cleaner wrasse, *Labroides* sp. (Labridae), was observed repeatedly at Rose Atoll and Ofu/Olesega. The color pattern of this fish is distinct from that of the redlip cleaner wrasse, *L. rubriolabiatus*. This species may be undescribed.

- Cleaner mimics, *Aspiodontus taeniatus* (Blennidae), were found infrequently at Rose Atoll and at Ofu/Olosega. This species resembles closely the cleaner wrasse *Labroides dimidiatus* (Labridae) and may be mistaken for it.

- A cleaner wrasse similar to *Labroides dimidiatus* with a yellow/orange band or spot ¾ of the way back towards the caudal region.

- A flasher wrasse of the genus Cirrhilabrus. This species is tentatively being recorded as *Cirrhilabrus katherinae*, but laboratory analysis of four captured individuals will be necessary to confirm this identification. *Cirrhilabrus "katherinae*" (Labridae) was very common within Rose Atoll Lagoon and also observed in certain sand and rubble habitats outside of the lagoon. This species is known previously from marginal localities along the Pacific/ Philippine plate boundaries (i.e., Izu Islands, Mariana Islands, but also Pohnpei). If the identity of this species is confirmed, this represents a considerable range extension for this species. A terminal phase male and three initial phase presumptive females were collected with handnets from rubble and *Caulerpa* patches on and at the bottom of a slope at Station ROS 8, a collecting station, near the inner edge of the lagoon pass at a depth of 10-13 m.

Damselfish:

- A charcoal grey damselfish fading to white/lighter grey towards the posterior. Smaller individuals show a distinct yellow fringe at the top of the dorsal fin. This yellow mark is faint or absent on larger individuals.

- A small, bright blue damselfish with a dark ocellus above the caudal peduncle. Some individuals show yellow margins to dorsal and anal fins. Most likely this species is *Chrysiptera taupou*.

- *Stegastes fasiolatus* (Pomacentridae) had "white tail" morph that was found solely at Tau Island, was absent from Rose Atoll, and dominated or coexisted with the normal morph at Ofu/Olosega. It is not known if this is simply a color variant of *S. fasciolatus* or if this is a different species. Photographs were taken of this fish but no specimens were collected.

- Another damselfish, possibly *Stegastes insularis* (Pomacentridae), was observed on a single station at Rose Atoll. This species is known only from Christmas Island (Line Islands) and Marcus Island.

- An unidentified species of damselfish, *Pomacentrus* spp. (Pomacentriedae), dusky blue in color, was observed rarely at Ofu/Olosega.

Swain's Island

From 15 to17 February 2004, the fish census team surveyed eight stations at Swains. Of these, one station was new and seven were resurveys ("monitoring") of sites established by CRED in February of 2002. Quantitative belt transects (BLT), stationary point counts (SPC), and qualitative REA surveys (for species presence) were conducted at each of these sites, using the same methodology as in 2002 and summarized in the first report of this cruise. The benthic team (corals, algae, invertebrates) followed the fish team at all sites.

Our general impression (pending statistical confirmation) was that large fish were slightly more abundant at Swains than at either Rose Atoll or the Manua Islands. Most common were snapper (mainly *Lutjanus bohar*), followed by parrotfish and surgeonfish (mainly *Naso* spp.). Bumphead parrotfish (*Bolbometopon muricatum*) were not observed on any of the dives. Humphead wrasse (*Cheilinus undulatus*) were present and some individuals larger than 100 cm were observed, but this species was not abundant. An apparent resident spawning aggregation was observed by the tow team, however. Groupers were mostly represented by small *Cephalopholis* spp.

It was reported that about two dozen people now reside on Swains Island, compared to only a family of four in 2002. Most species of larger fish (e.g., >20 cm TL) are potential fishing targets primarily by spear for subsistence (e.g., snapper [except *Lutjanus bohar*, which is believed to be ciguatoxic], parrotfish, surgeonfish, jacks, grouper). It is unknown what, if any, level of fishing from outside pressure Swains receives.

Fish habitat appeared to be of highest quality (e.g., percent and diversity of live coral cover and substrate relief) on the N side of the island. The W side appeared to be of lowest habitat quality (e.g., broken and dead coral overgrown by algae) as it was heavily impacted by recent storms.

The total number of coral reef fish species CRED documented in 2002 for Swains Island was 168. The total number of species we observed in 2004 was about 220, again reflective of greater observation effort in 2004.

Fish Family Summaries

Twenty species of damselfishes (Pomacentridae) representing eight genera were observed. The midget chromis (*Chromis acares*), the bicolor chromis (*Chromis margaritifer*), the black damsel (*Chromis xanthura*), Dick's damsel (*Plectroglyphididon*

dickii), and the Johnston Island damsel (*Plectroglyphididon johnstonianus*) were among the most commonly seen species. As in 2002, the midget chromis appeared to have the highest numerical density of all fish. No effort was made to collect *Dascyllus auripinnis* because only three individuals were observed at this locality. Curiously, a common and nearly ubiquitous species elsewhere in American Samoa, the princess damsel (*Pomacentrus vaiuli*), was not observed, nor was a common upper terrace species, the Pacific Gregory (*Stegastes fasciolatus*).

Twenty-eight species of surgeonfishes (Acanthuridae) representing four genera were observed. Frequently observed species included Thompson's surgeonfish, *Acanthurus thompsoni* (over the drop-off), the blacktongue unicornfish (*Naso hexacanthus*), the bluespine unicornfish (*Naso unicornis*), and the bignose unicornfish (*Naso vlamingii*). The barred unicornfish (*Naso thynnoides*) was also observed and represents a range extension for this species (known from the Gilbert Islands west to East Africa).

Thirty-seven species of wrasses (Labridae) representing 16 genera were observed. The most frequently observed species included various cleaner wrasses (*Labroides bicolor, Labroides dimidiatus, Labroides pectoralis,* and *Labroides rubrolabiatus*), the bird wrasse (*Gomphosus varius*), the ringtail wrasse (*Oxycheilinus unifasciatus*), the six-line wrasse (*Pseudocheilinus hexataenia*), the barred thicklip (*Hemigymnus fasciatus*), and the wedge-tailed wrasse (*Labropsis xanthonota*). The most common species, however, appears to be the redribbon wrasse (*Thalassoma quinquivittatum*). The humphead wrasse, *Cheilinus undulatus*, has been discussed above. *Pseudocheilinus ocellatus* was also observed and represents a new record.

Twelve species of groupers (Serranidae: Epinephelinae), four species of fairy basslets (Serranidae: Anthiinae), and one species of soapfish (Serranidae: Diploprionini) representing eight genera were observed. The most commonly observed species were the flagtail grouper (*Cephalopholis urodeta*), a smaller species, and the peacock grouper (*Cephalopholis argus*). The leopard hind (*Cephalopholis leopardus*) was observed in holes along wall faces and in deep coral. The hexagon grouper (*Epinephelus hexagonatus*) was observed in shallower water and was of relatively large body size (20-30 cm) for this normally small species. The blackspot grouper (*Epinephelus melanostigma*) was somewhat cryptic but spotted easily as it moved away from divers.

Ten species of snappers (Lutjanidae) from four genera were observed. The twinspot or dogtooth snapper (*Lutjanus bohar*) was observed commonly on the lower terrace and down the reef slope, but also hovering above the slope. The onespot snapper (*Lutjanus monostigmus*), the blacktail snapper (*L. fulvus*), and the humpback snapper (*L. gibbus*) appeared to be most common in the lower spur and groove zone (off the transects but detected during REA swims). Both *Macolor macularis* and *Macolor niger* were observed frequently.

Nine species of parrotfishes (Scaridae) from four genera were observed. The most commonly seen species were whitespot parrotfish (*Scarus forsteni*) and the redlip parrotfish (*Scarus rubroviolaceus*).

Eight species of jacks or trevallys (Carangidae), including the rainbow runner (*Elegatis bipinnulata*), the leatherjacket (*Scomberoides lysan*), and the small-spotted pompano (*Trachinotus bailloni*) were observed. More commonly seen species included the bluefin trevally (*Caranx melampygus*), the bigeye trevally (*Caranx sexfasciatus*), the black trevally (*Caranx lugubris*), the giant trevally (*Caranx ignobilis*), and the yellow-spotted trevally (*Carangoides orthogrammus*).

Several large dogtooth tuna (*Gymnosarda unicolor*) were observed. Some individuals were in excess of 1.5 m in length.

A large school of approximately 100 blackfin barracuda (*Sphyraena genie*) were observed at one site along the north coast. When not ciquatoxic, this species is a common food fish. It is unknown whether or not it is consumed at Swains.

Ten species of triggerfishes (Balistidae) from seven genera were observed. The pinktail triggerfish (*Melichthys vidua*) and the black triggerfish (*Melichthys niger*) were quite common in the water column above the terrace, upper slope, and lower spur and groove zone (the latter off transects but surveyed by REA swims). The orange-striped triggerfish (*Balistapus undulatus*) was observed frequently in coral areas while the scythe triggerfish (*Sufflamen bursa*) was not uncommon in coral and rubble habitats.

Seven species of hawkfishes (Cirrhitidae) of three genera were observed. One may be a new species of the genus *Paracirrhites* (filmed on video by Craig Musburger, but not collected). The yellow hawkfish (*Paracirrhites xanthus*) was observed in harems but abundances were very low. *Paracirrhites arcatus*, in both normal and melanistic morphs, were very abundant. The flame hawkfish (*Neocirrhites armatus*) was observed in *Pocillopora eydouxi* (?) coral heads but was rare, however.

Sharks were rare and represented by just two species, the grey shark (*Carcharhinus amblyrhynchos*) and the whitetip shark (*Triaenodon obesus*) (both Carcharhinidae); both had low abundances and were relatively small. Greys were generally seen cruising along the reef crest, while whitetips tended to be observed deeper along dropoffs.

Notes on Rare Species, Alternate Color-morphs, and Range Extensions

At least one new species, a hawkfish (*Paracirrhites* sp.), was observed and filmed but not collected. The yellow hawkfish, *Paracirrhites xanthus*, was rare and Swains Island appears to be at the western edge of its range. The arc-eye hawkfish (*Paracirrhites arcatus*) and the whitespot hawkfish (*Paracirrhites hemistictus*) were present in two color morphs (melanistic morphs tended to be in shallower water but not exclusively so). The blackside hawkfish (*Paracirrhites forsteri*) had several color morphs present. A wrasse, *Pseudocheilinus ocellatus*, normally seen in the western Pacific but seen in the east-central Pacific only at Johnston Island and Pitcairn Island, was seen by a tow team diver. This species is secretive and may likely be found at most localities in the region. The barred unicornfish, *Naso thynnoides*, was present, thus extending its range eastward

(see also Rose Atoll). Some individuals of the flagtail grouper (*Cephalopholis urodeta*) observed below 50 ft had a curious "koi" color pattern seen usually at other oceanic islands, mainly in the western Pacific (Donaldson, unpublished data). This color pattern, which is fixed and not controlled behaviorally, departs considerably from this species' normal coloration.

Previously Known or Expected Species Rare or Absent from Localities

Two damselfishes, *Pomacentrus vaiuli* and *Stegastes fasciolatus*, appeared to be absent from Swains Reef. Both species are common throughout the central and western Pacific and occur elsewhere in American Samoa. Rabbitfishes (Siganidae) were also not seen.

Species with Uncertain Identifications

Three fish species observed at Swains were not identifiable in the field. We collected video and still photographic images for all three species which will allow for positive identification upon return to Honolulu. Summarized here are brief descriptions of the questionable species with our suspected identifications included.

Hawkfish:

- A questionable hawkfish (Cirrhitidae), *Paracirrhites* sp. which resembles closely *P. arcatus*, but which has dark black lines bordering a white line running from the middle to the caudal peduncle. This is possibly a new species which remains to be collected and described. Photographs and videos were taken.

Wrasse:

- A questionable *Labropsis* sp. wrasse has been identified as a juvenile color morph of the chiseltooth wrasse, *Pseudodax moluccanus* (Labridae).

Blenny:

- A light-colored blenny with yellow spots has not been identified.

Tutuila

From 18 to 25 February 2004, the fish census team (Robert Schroeder, Terry Donaldson, and Craig Musburger) surveyed 22 total stations in the vicinity of Tutuila, including one at Taiema Bank (just S of Pago Pago Harbor), one at Aunuu, and 20 around the large Island of Tutuila. Habitats included reefs within bays and exposed outer reef slopes. Of these, 9 stations were new and 13 were resurveys ("monitoring") of sites established by CRED in February of 2002. Twelve of these sites were off villages, which implement some form of marine tenure of their nearshore reef resources. Quantitative belt transects (BLT), stationary point counts (SPC), and qualitative REA surveys (for species presence) were conducted at each of these sites, using the same methodology as in 2002 and summarized in the first report of this cruise. The benthic team (corals, algae, invertebrates) followed the fish team at all sites.

Our general impression was that fish assemblages were basically similar to that found in CRED's initial cruise, 2 years ago. Large fish density still appeared to be rather low and quite possibly (pending statistical confirmation) lower than the other islands of American Samoa. Tutuila has the largest island population with well over 90% of the territory's residents. For example, sharks were extremely rare as only about four individuals were seen by the fish team during its entire time underwater (66 man-dives, each over an hour long of observation). Subsistence and commercial fishing are common but a ban on fishing with scuba was implemented about 2 years ago. Common target species include surgeonfish, grouper, snapper (except larger *Lujanus bohar*, which are believed ciguatoxic), wrasse, parrotfish, and jacks. As in February 2002, recruitment was heavy for some species, especially the striped bristletooth (*Ctenochaetus striatus*). The site (Nuuuili, TUT-10) of the seaside road construction/fill activity of 2002, which produced an increase of sedimentation and algae then, did not appear noticeably different in fish habitat or assemblage composition during our 2004 survey (pending statistical confirmation).

The total number of coral reef fish species CRED documented in 2002 for Tutuila was 228 (compared to 173 species reported in Alison Green's surveys of 1994-95). The total number of species we observed in 2004 was 338, again as a result of greater observation effort than in 2002.

Impact of the recent (late December) hurricane was clearly evident at many of the stations (e.g., broken and overturned corals, leaves, branches, and occasional garbage on the bottom). Conditions at about half of the sites along the north side of Tutuila were hampered by large swells, resuspending sediment in the water column and greatly reducing visibility (e.g., 1-4 m). At about three of these stations, the quantitative fish data is not representative, especially for the Stationary Point Count (SPC) method, which requires 10 m of minimum visibility. While few fish could be seen, it is believed that many sought shelter in holes of deeper water.

Fish Family Summaries

Twenty-eight species of surgeonfishes (Acanthuridae) representing five genera were observed. The most frequently observed species was the striped bristletooth, *Ctenochaetus striatus*. Thousands of juveniles (ca. 5-8 cm, TL) were seen on and adjacent to transects at many sites. The bluespine unicornfish (*Naso unicornis*), the brown surgeonfish (*Acanthurus nigrofuscus*), and the mimic surgeonfish (*Acanthurus pyroferus*) were also seen commonly. The Palette surgeonfish (*Paracanthurus hepatus*), popular in the aquarium trade (elsewhere), was also seen although rarely.

Fifty-four species of wrasses (Labridae) representing 20 genera were observed. The most frequently observed species included various cleaner wrasses (*Labroides bicolor*, *Labroides dimidiatus*, *Labroides pectoralis*, and *Labroides rubrolabiatus*), the bird wrasse (*Gomphosus varius*), the ringtail wrasse (*Oxycheilinus unifasciatus*), the six-line wrasse (*Pseudocheilinus hexataenia*), the barred thicklip (*Hemigymnus fasciatus*), and the checkerboard wrasse (*Halichoeres hortulanus*). The redribbon wrasse (*Thalassoma*

quinquivittatum) was also common. The humphead wrasse, *Cheilinus undulatus*, was quite uncommon.

Fifteen species of groupers (Serranidae: Epinephelinae), two species of fairy basslets (Serranidae: Anthiinae), and one species of Swiss Guard basslet (Serranidae: Liopropomini) representing eight genera were observed. The most commonly observed species were the flagtail grouper (*Cephalopholis urodeta*), a small-sized species, and the peacock grouper (*Cephalopholis argus*). The leopard hind (*Cephalopholis leopardus*) was observed in holes along wall faces and in deep coral. The hexagon grouper (*Epinephelus hexagonatus*), the blacksaddle grouper (*Epinephelus howlandi*), the blackspot grouper (*Epinephelus melanostigma*), two coral trouts (*Plectropomus areolatus* and *P. laevis*), and the slenderspine grouper (*Gracila albomarginata*) were rarely seen. The blacktip grouper (*Epinephelus fasciatus*) and a species that resembles it closely, the Red-tipped grouper (*Epinephelus retouti*) were both seen but were also rare. Fairy basslets were not common at all.

Nine species of snappers (Lutjanidae) from four genera were observed. The twinspot or dogtooth snapper (*Lutjanus bohar*) was observed commonly on the lower terrace and down the reef slope, but also hovering above the slope. The onespot snapper (*Lutjanus monostigmus*), the blacktail snapper (*L. fulvus*) and the humpback snapper (*L. gibbus*) were seen only occasionally. *Macolor macularis* and *Macolor niger* were observed frequently, the former species more frequently.

Eighteen species of parrotfishes (Scaridae) from four genera were observed. The most commonly seen species were the bullethead parrotfish (*Chlorurus sordidus*), the whitespot parrotfish (*Scarus forsteni*), the redtail parrotfish (*Scarus japanicus*), the dark-capped parrotfish (*Scarus oviceps*), the palenose parrotfish (*Scarus psittacus*), and the redlip parrotfish (*Scarus rubroviolaceus*).

Eight species of jacks or trevallys (Carangidae), including the rainbow runner (*Elegatis bipinnulata*), the leatherjacket (*Scomberoides lysan*) and the small-spotted pompano (*Trachinotus bailloni*), seen in schools at the north tip of the Cock's Comb, a high energy area along a split cliffline) were observed. The most commonly seen species was the bluefin trevally (*Caranx melampygus*).

Eighteen species of butterflyfishes (Chaetodontidae) from four genera were observed. The most commonly observed species included the reticulated butterflyfish (*Chaetodon reticulatus*), the saddled butterflyfish (*Chaetodon ephippium*), the raccoon butterflyfish (*Chaetodon lunula*), the speckled butterflyfish (*Chaetodon citrinellus*), the ornate butterflyfish (*Chaetodon ornatissimus*), the chevroned butterflyfish (*Chaetodon trifascialis*) (around *Acropora* sp. table corals), the forceps butterflyfish (*Forcipiger flavissimus*), the longnose butterflyfish (*Forcipiger longirostris*), the pennant bannerfish (*Heniochus chrysostomus*), and the humphead bannerfish (*Heniochus varius*). Rare butterflyfishes included the dotted butterflyfish (*Chaetodon semion*) and the black-backed butterflyfish (*Chaetodon melannotus*).

Thirty-nine species of damselfishes (Pomacentridae) representing eight genera were observed. The midget chromis (*Chromis acares*), the bicolor chromis (*Chromis margaritifer*), the half and half chromis (*Chromis iomelas*), the black damsel (*Chromis xanthura*), the taupou damsel (*Chrysiptera taupou*), the Dick's damsel (*Plectroglyphididon dickii*), the Johnston Island damsel (*Plectroglyphididon johnstonianus*), princess damsel (*Pomacentrus vaiuli*), the charcoal damsel (*Pomacentrus brachialis*), and the Pacific Gregory (*Stegastes fasciolatus*) were among the most commonly seen species. Clownfishes (*Amphiprion chrysoptera* and *A. melanopus*) were seen occasionally in association with anenomes.

Eleven species of triggerfishes (Balistidae) from seven genera were observed. The pinktail triggerfish (*Melichthys vidua*) and the black triggerfish (*Melichthys niger*) were quite common in the water column above the terrace, upper slope, and lower spur, and groove zone. The orange-striped triggerfish (*Balistapus undulatus*) was observed frequently in coral areas and the scythe triggerfish (*Sufflamen bursa*) was not uncommon in coral and rubble habitats.

Notes on Rare Species, Alternate Color-morphs, and Range Extensions

Melanistic or alternate color morphs of various species were not commonly observed compared to Rose Atoll or Swains Island. Several color morphs of the freckled hawkfish (*Paracirrhites forsteri*) were observed on and adjacent to transects. No relationship between color morph and habitat type has been established, however. Range extensions for and the rarity of some species remain to be verified.

Species with Uncertain Identifications

Several fish species have not been identifiable in the field. We have collected video and still photographic images for all of the unidentified species which will allow for positive identification upon return to Honolulu. Summarized here are brief descriptions of the questionable species. For full descriptions of species mentioned in previous reports, please refer to those reports (report 1 = Manua/Rose; report 2 = Swains).

Wrasses:

- Labroides sp. (see full description in report 1)
- Oxycheilinus sp. (see full description in report 2)
- Thalassoma sp. This wrasse had mottled black bands/patches over a greenish/white base and was seen occasionally foraging over current-swept colonized pavement and rubble areas.

Damselfishes:

- Pomachromis sp. (see full description in report 1)
- Charcoal/white damselfish (see full description in report 1)
- A blue/grey damsel previously reported as unidentified has now been positively identified as Pomacentrus brachialis.

Jacks:

- A large (60 cm) silver carangid with extremely long (>1 m) streamers extending from the tips of the dorsal and anal fins. This species was most likely either *Alectis ciliaris* or *A. indicus*. It is unusual for an individual of such large size to retain the streamers.

Scorpionfish:

- *Scorpaenopsis* sp.? (photographed by Dr. James Maragos).

Appendix B: **Coral Rapid Ecological Assessment (REA) Team Activity Report** (*Jean Kenyon and James Maragos*)

Manua Island and Rose Atoll

Introduction

Two investigators, Jean Kenyon of the Coral Reef Ecosystem Division (CRED) and Jim Maragos of the U.S. Fish and Wildlife Service (USFWS), served as the coral dive team, participating in reef studies off four islands to the east of the main island of Tutu'ila in American Samoa. Three of the islands, Ta'u, Ofu, and Olosega are volcanic and a part of the Manu'a group while the fourth, Rose (Nu'u o Manu), is an atoll further to the east and a National Wildlife Refuge administered by the USFWS.. Although both investigators participated at all but four of the site surveys, results presented below are preliminary because the two investigators have not yet had the time to combine their respective data. Only Kenyon's field data are reported here for Ofu, Olosega, and Ta'u, and only Maragos' field data are reported here for Rose.

Methods

Coral survey methodology used at Manu'a and Rose is the same previously used during the Johnston, Howland, and Baker phase of the 2004 Equatorial survey (OES 04-01). At each REA site, the first two 25-m transect lines previously laid out by the fish team were videotaped. Kenyon collected the videotapes and will use them later to analyze percent cover data. The tapes also provide a permanent record of the condition of the benthos at each REA site. Both investigators shared in field collection of coral population and size distribution data. Each coral whose center fell within 0.5 to 1.0 m along the first two transect lines were identified in situ to genus and assigned to one of 7 size classes based on the estimated length of their longest diameters; the seven size classes are: <5 cm, 6-10, 11-20, 21-40, 41-80, 81-160, and >160 cm. In addition, evidence of coral bleaching and disease were noted and photographed at the few sites where observed. Moreover, both investigators endeavored to take digital photographs of coral species, including those within a broader area beyond the transect lines to compile and document a more complete inventory of coral biodiversity at each REA site.

Additionally, Maragos resurveyed his two 2002 permanent monitoring sites at Rose Atoll and established two new permanent monitoring sites, each 50 m in length, off the SW ocean facing reef. At each permanent site, a 50-m surveyor's tape was laid out along each transect alignment marked with stainless steel stakes previously installed at 5-m intervals. A 1-m^2 quadrat was laid sequentially and photographed along the entire transect at 1-m intervals for a total coverage of 50 m^2 per transect. These data will be later analyzed for the same parameters as the REA coral census data: percent coral cover, size class distribution, frequency, mean diameter, generic diversity, etc. John Rooney and Megan Moews kindly assisted in the permanent transect surveys.

Ta'u

Nine sites were surveyed by the coral team. Site locations are shown in Figure 1. Of these nine sites, three were previously surveyed by CRED in 2002, two were surveyed by David Fisk and Charles Birkeland for the American Samoa government in 2002, and the remaining four sites were chosen on the basis of guidance provided by the American Samoa Coral Reef Monitoring plan or to fill in spatial gaps in survey locations. Most sites were characterized by low (i.e., relatively flat) topographical relief and were colonized by encrusting *Montipora* and *Porites* as well as by numerous small (< 20 cm maximum diameter) colonies that form massive or branching morphologies. The only sites deviating from this general pattern were Ta'u 12, on the southwest side of the island, which was characterized by moderately high topographical relief, and Ta'u 10, in a small cove on the north side of the island, which was characterized by coarse, wave-sculpted sand and boulders colonized by filamentous algae.

Colonies belonging to 23 anthozoan genera were observed by Kenyon and counted within belt transects during quantitative surveys (Table 1). Members of the genera M*ontipora, Astreopora, Favia,* and *Porites* dominated the coral fauna in terms of number of colonies, with each genus contributing more than 10% of the total number of colonies. Visual estimates of percent live coral cover ranged from <1% at the sand/boulder site on the north shore mentioned above (Ta'u-10), to 40% at a site on the south shore near the outfall of Lafuti stream (Ta'u-2); visual estimates of percent cover await comparison with values derived from computer-assisted quantitative analysis of videotapes recorded along transect lines. A total of 1098 coral colonies (of which 1085 were scleractinians) were counted within a total survey area of 241 m^2, for an average colony density of 4.5 coral colonies/m^2. Density values at individual sites ranged from 1.0/m^2 at site Ta'u-10 to 13.6/m^2 at a site off the southwest coast (Ta'u-12). Generic diversity values followed patterns similar to those for percent cover and colony density, with the lowest generic diversity at Ta'u-10, and the highest generic diversities observed at Ta'u-12 and Ta'u-2. Inspection of a histogram showing the size class distribution of anthozoan colonies counted and classified within belt transects shows that the majority (81.0 %) of colonies measure less than 20 cm in maximum diameter, with the greatest number of colonies occurring within the 5-10-cm size class.

Ofu and Olosega

Four sites were surveyed by the coral team at each of Ofu and Olosega, for a total of eight sites. Site locations are shown in Figure 2. Of these eight sites, three were previously surveyed by CRED in 2002, three were surveyed by David Fisk and Charles Birkeland for the American Samoa government in 2002, and the remaining two sites were chosen on the basis of guidance provided by the American Samoa Coral Reef Monitoring plan or to fill in spatial gaps in survey locations. Topographical relief varied considerably among sites surveyed, from sites characterized by low rugosity and moderate to high levels of encrustation with *Montipora* and *Porites* to sites with high rugosity, frequently accompanied by relatively high coral diversity.

Colonies belonging to 28 anthozoan genera were observed by Kenyon and counted within belt transects during quantitative surveys (Table 1). Members of the genera M*ontipora, Goniastrea ,* and *Porites* dominated the coral fauna in terms of number of colonies, with each genus contributing more than 10% of the total number of

colonies. Visual estimates of percent cover by live coral ranged from 2% at a site off the southeast exposure of Olosega (Olo-6) to 45% at a site with an eastern exposure (Olo-1); visual estimates of percent cover await comparison with values derived from computer-assisted quantitative analysis of videotapes recorded along transect lines. It is interesting to note, however, that these two sites, so disparate in terms of estimated percent cover, showed the same generic diversity within surveyed belt transects and were at the low end of the range of generic diversity indices calculated for each of the survey sites. A total of 1710 anthozoan colonies (of which 1607 were scleractinians) were counted within a total survey area of 327 m^2, for an average colony density of 5.2 anthozoan colonies/m^2. Density values at individual sites ranged from 3.2/m^2 at a site off Ofu village (Ofu-6), to 20.9/m^2 at a site off Olosega village (Olo-4); the latter site was also characterized by the greatest generic diversity. Inspection of a histogram showing the size class distribution of anthozoan colonies counted and classified within belt transects (Fig. 4) shows that the majority (88.0 %) of colonies measure less than 20 cm in maximum diameter, with the greatest number of colonies occurring within the 5-10-cm size class.

Visual comparison of size class data from both Ta'u and Ofu/Olosega with size class data derived from 2002 surveys conducted by CRED coral biologist Kenyon suggests a reduction in the proportion of colonies in larger (>20 cm) size classes tallied during 2004 surveys. While this preliminary observation could be an artifact of variation among sites surveyed and requires statistical analysis for validation, such a preliminary observation, if validated, could be a result of a typhoon that affected the high islands of American Samoa in early January 2004. Broken colonies of branching corals and unconsolidated rubble were noted in the course of several surveys, as well as sheared branches of intact *Pocillopora* colonies that were not yet colonized by epiphytic algae. Coral biologist James Maragos also noted a vast difference between luxuriant coral growth recalled from a 1992 survey at a new CRED site (Ofu-8) just south of the sea arches on the west coast of Ofu and the present, scoured condition of the reef in both shallow (<15 ft) and deeper (45-50 ft.) water. Moreover, he and others also reported more luxuriant coral growth in 1992 at an adjacent site (Ofu-6), (Maragos, Hunter, and Meier 1994). Maragos briefly interviewed two fishers at the latter site who indicated that several large rainstorms over the past year, including the recent hurricane contributed to the demise of corals at site Ofu-6.

Rose Atoll

Rose Atoll is diamond shaped, measuring two km on a side, and with the ocean sides facing NE, SE, SW, and NW (Fig. 3). In October1993, Rose experienced a ship grounding and associated fuel spill that killed off corals and coralline algae over a broad reach of the SW reef crest and upper reef margins. Later dissolved iron from the wreckage stimulated growths of invasive cyanobacteria that still carpet much of the SW reef crest and slopes that discouraged recovery of coralline algae and corals. Shortly after the grounding in April 1994, Rose experienced massive coral bleaching in all habitats to depths of 20-25 m that was witnessed by Maragos (1994) who accomplished the first post-shipwreck coral surveys at ocean-facing reef slopes and lagoon back reefs along all four sides of the atoll. In 1999-2000, Maragos revisited Rose as part of an emergency partial cleanup of the ship debris, and established eight permanent transects at the base of patch reefs in the lagoon but was unable to resurvey ocean reefs. During the 2002

Cromwell visit to Rose, four of the lagoon sites were revisited and three new permanent transects established, one in the central lagoon, and two off the SW ocean-facing reef (Ros-5, -7). REA surveys were also accomplished on all four ocean-facing sides of the atoll in 2002.

In 2004, a total of 12 REA surveys were accomplished at Rose, with 10 on ocean reefs and two in the lagoon. Four of the sites were located off the SW ocean-facing reef slope, two up-drift and two down-drift of the remains of the 1993 shipwreck on the upper reef slope, and permanent transects were also resurveyed (Ros-5P, -7P) or established (Ros-4P, -23P) at all four of these sites. Three additional REA sites were off the SE ocean-facing reef (Ros-2, -3 –21), two off the NW ocean-facing reef (Ros-6, -22), and one off the NE ocean-facing reef (Ros-1), all at depths between 10-15 m. One lagoon REA site (Ros-8) was situated in the N lagoon near the pass, and the other (Ros-9) was situated near the opposite corner just off the SW backreef of the lagoon (Fig. 3) at depths of 12-13 m. Nine of the 12 sites in 2004 were previously surveyed during the January 2002 *Townsend Cromwell* expedition, and three were new sites (Ros-21, -22, -23P).

A total of 2,478 corals were censused by Maragos at six ocean and two lagoon REA sites, but only 33 individual stony corals (mostly *Montipora, Favia* and *Pavona*) and 11 soft corals (*Lobophyton*) contributed to the two largest size classes (>80 cm). All ocean reef slope sites showed numerous colonies of *Pocillopora* except off the NW reef slope. Other coral genera were also numerous on exposed, more windward sites (Ros-1, -2, -3, 4P), including (in descending order of abundance), *Montastrea, Montipora, Lobophyton, Favia, Porites, Acropora* and *Pavona*,(Table 1), but none of these were especially abundant off the NW (Ros-6, -22) reefs, and most were not large.

Few generalizations can be made for lagoon coral communities since only two disparate sites were surveyed (Ros-8, -9). Small colonies of *Porites* were unusually abundant and remaining coral genera not abundant at Ros-8 near the pass. In contrast *Montipora, Favia,* and *Astreopora* were unusually abundant at Ros-9 near the SW back reef. Although common on ocean reefs, *Pocillopora* and *Lobophyton* were nearly absent at the two lagoon sites.

Coral frequencies were highest (12.7 corals/m^2) at the SW lagoon site (Ros-9) and moderate at all ocean-facing reefs except those along the two NW ocean-facing sites, ranging between 3.5 and 5.5 corals/m^2. Coral colonies were lowest along the NW ocean-facing reefs (2.2 to 3.1 corals/m^2) at sites Ros-6 and Ros-22, respectively. Coral frequency was moderate, averaged 3.6 corals at the remaining lagoon site near the pass (Ros-8). Coral frequency appeared to be directly correlated to percent coral cover visually estimated during the REA surveys. The highest cover (60%) was estimated at site Ros-9 in the SW lagoon, the lowest (5-15%) at the two NW ocean-facing sites (Ros-6, -22) and nearby northern lagoon site (Ros-8). Remaining ocean facing reefs varied from 20 to 40% live coral cover. Likewise, generic diversity at the transect sites was highest off the ocean reef sites (except the SW) ranging from 13-16 genera and lowest off the lagoon and NW ocean reefs, ranging from 8-10 genera per transect.

Although comparisons are not yet available for the permanent transect data, coral communities appear to be recovering from the coral bleaching of 1994 that affected all reefs, and from the 1993 ship grounding, that affected corals mostly at SW ocean and lagoon reefs (Ros-4P, -5P, -7P, -9P, 23P). Coral recolonization appears more diverse at ocean sites removed from the shipwreck, including several common coral genera other

than *Pocillopora.* The lack of many large colonies anywhere at the atoll to 2004 suggests that most corals at the shallow depths died after the 1994 bleaching event and that coral recovery is still ongoing. It is more difficult to explain the lower coral development (frequency, cover, diversity) at the two NW ocean sites (Ros-6, -22) but may be related to anomalous high temperatures off these reefs. The reef crest also looks deeper and less developed compared to the other more exposed reef faces (SE, SW, NE sides) elsewhere around the atoll perimeter. Additional oceanographic and coral reef monitoring may help elucidate the causes for the depressed coral abundance there.

Table 1. Number of corals (Class Anthozoa and Hydrozoa) reported at the REA sites at Ta'u and Ofu/Olosega by Kenyon and at Rose Atoll by Maragos during January 2004 surveys

	Ta'u		**Ofu/Olosega**		**Rose**	
coral genera	**# of corals**	**percent of total**	**# of corals**	**percent of total**	**# of corals**	**Percent of total**
Acanthastrea	2	0.20%	6	0.40%	0	0.00%
Acropora	85	7.70%	34	2.00%	121	4.86%
Astreopora	174	**15.80%**	86	5.00%	134	5.58%
Coscinaraea	0	0.00%	1	0.10%	13	0.52%
Cyphastrea	0	0.00%	0	0.00%	50	2.08%
Diploastrea	0	0.00%	0	0.00%	0	0.00%
Echinophyllia	0	0.00%	0	0.00%	2	0.08%
Echinopora	2	0.20%	8	0.50%	0	0.00%
Favia	139	**12.70%**	160	9.40%	273	**10.96%**
Favites	50	4.60%	29	1.70%	3	0.12%
Fungia	3	0.30%	8	0.50%	6	0.24%
Galaxea	31	2.80%	147	8.60%	0	0.00%
Gardineroseris	0	0.00%	0	0.00%	0	0.00%
Goniastrea	100	9.10%	234	**13.70%**	1	0.04%
GonioporaAlveopora	0	0.00%	4	0.20%	0	0.00%
Hydnophora	2	0.20%	3	0.20%	2	0.08%
Leptastrea	64	5.80%	51	3.00%	38	1.52%
Leptoseris/Pachyseris	0	0.00%	0	0.00%	23	0.92%
Lobophyllia/Symphyllia	0	0.00%	2	0.10%	7	0.28%
Merulina/Scapophyllia	2	0.20%	4	0.20%	2	0.08%
Millepora	0	0.00%	7	0.40%	0	0.00%
Montastrea	11	1.00%	34	2.00%	417	**16.75%**
Montipora	185	**16.80%**	298	**17.40%**	350	**14.06%**
Oulophyllia	0	0.00%	0	0.00%	0	0.00%
Palythoa/Zoanthus	1	0.10%	1	0.10%	1	0.04%
Pavona	3	0.30%	9	0.50%	132	5.30%
Platygyra/Leptoria	32	2.90%	130	7.60%	1	0.04%
Pocillopora	67	6.10%	146	8.50%	454	**18.23%**
Porites	128	**11.70%**	200	**11.70%**	143	5.74%

coral genera	Ta'u		Ofu/Olosega		Rose	
	# of corals	percent of total	# of corals	percent of total	# of corals	Percent of total
Psammocora	0	0.00%	10	0.60%	27	1.08%
Sandalolitha	3	0.30%	1	0.10%	0	0.00%
Sarcophyton	2	0.20%	5	0.30%	2	0.08%
Seriatopora	0	0.00%	0	0.00%	0	0.00%
Sinularia/Lobophytum	10	0.90%	90	5.30%	287	**11.53%**
Stylaster/Distichopora	0	0.00%	0	0.00%	0	0.00%
Stylophora	0	0.00%	0	0.00%	0	0.00%
Turbinaria	2	0.20%	2	0.10%	1	0.04%
Total area surveyed	241m2		327m2		546 m2	
Total # colonies:	1098		1710		2490	

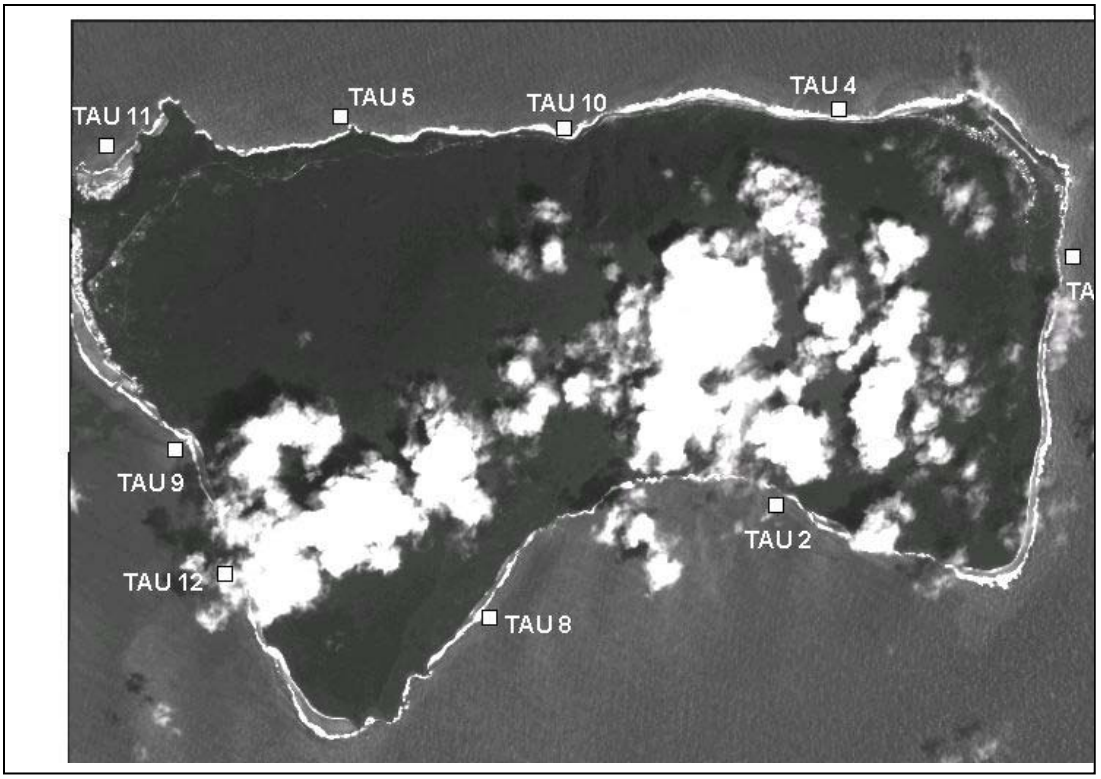

Figure 1. Locations (white squares) of coral team survey sites at Ta'u, Manua' group, American Samoa, February 2004

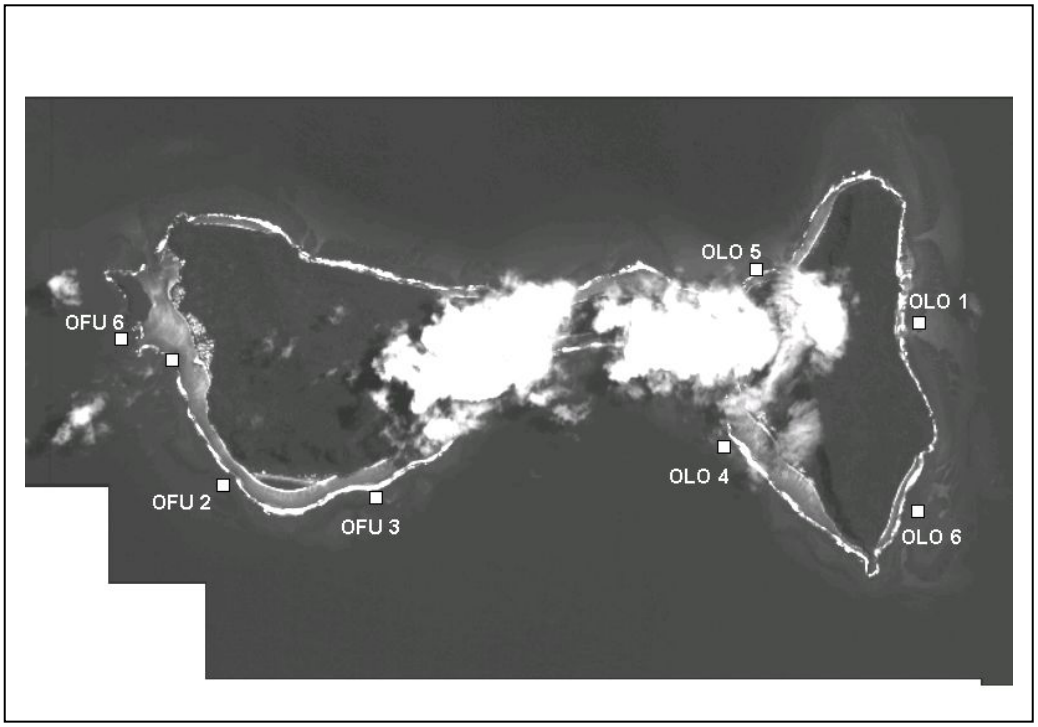

Figure 2. Locations (white squares) of coral team survey sites at Ofu and Olosega, Manu'a group, American Samoa, February 2004

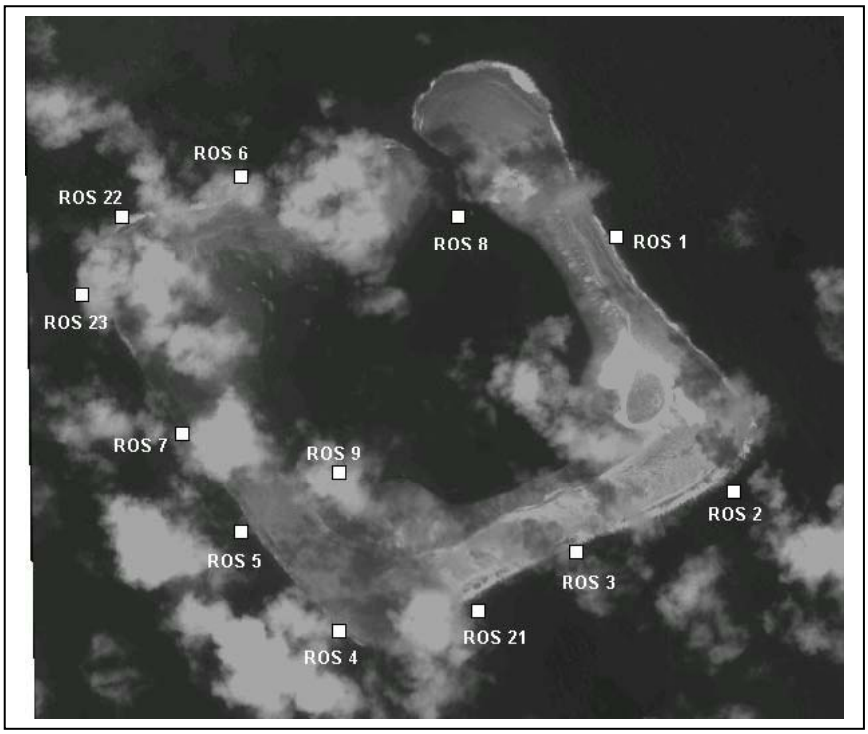

Figure 3. Locations (white squares) of coral team survey sites at Rose Atoll, American Samoa, February 2004

Swains Island and Tutuila

Introduction

From February 15 to 17, 2004, two investigators, Jean Kenyon of the CRED and Jim Maragos of the USFWS, served as the coral dive team, participating in reef studies off Swains Island, American Samoa, roughly 160 nmi to the north of Tutu'ila in American Samoa. . Both investigators then participated in 20 similar surveys off the main island of Tutu'ila in American Samoa and one survey each for Aunu'u Island and Taiema Bank from February 18 to 25, 2004. Although both investigators participated at most of the sites surveyed, results presented below are preliminary because the two investigators have not yet had the time to combine their respective data. Consequently, only Kenyon's field data are reported here for Swains, and only field data from Maragos are reported here for Tutu'ila. The discussion for Aunu'u and Taiema is combined with that of Tutu'ila since both are located a few miles south of the main island. Swains, a distant outlier from the rest of American Samoa, is treated separately.

Methods

Coral survey methodology used is the same previously used during the Manu'a Group (Ta'u, Ofu, Olosega) phase of the 2004 Equatorial survey (OES 04-02). At each REA site, the first two 25-m transect lines previously laid out by the fish team were videotaped. Kenyon recorded the videotapes and will use them later to analyze percent cover data. The tapes also provide a permanent record of the condition of the benthos at each REA site. Both investigators shared in field collection of coral population and size distribution data. Each coral whose center fell within 0.5 to 1.0 meters along the first two transect lines were identified in situ to genus and assigned to one of seven size classes based on the estimated length of their longest diameters; the seven size classes are: 1-5 cm, 6-10, 11-20, 21-40, 41-80, 81-160, and >160 cm. In addition, evidence of coral bleaching as well as predation by *Acanthaster* were noted and photographed at the few sites where observed. Moreover, both investigators endeavored to take digital photographs of coral species, including those within a broader area beyond the transect lines, to compile and document a more complete inventory of coral biodiversity at each REA site.

Additionally, Maragos resurveyed his two 2002 permanent monitoring sites at Swains Island and established one new permanent monitoring site, each 50 m in length. At each permanent site, a 50-meter surveyor's tape was laid out along each transect alignment marked with stainless steel stakes previously installed at 5-m intervals. A 1-m^2 quadrat was laid sequentially and photographed along the entire transect at 1-m intervals for a total coverage of 50 m^2 per transect. These data will be later analyzed for the same parameters as the REA coral census data: percent coral cover, size class distribution, frequency, mean diameter, generic diversity, etc. Megan Moews and Kelly Stroud kindly assisted in the permanent transect surveys at Swains. No permanent transects are established at Tutu'ila, Aunu'u, or Taiema.

Swains Island

Nine sites were surveyed by the coral team (Fig. 1), including the western shallow reef flat (not shown). Of these nine sites, seven were previously surveyed by CRED in 2002, while the remaining sites were chosen to fill in a spatial gap in survey locations. When surveyed in 2002, most sites were characterized by luxuriant growth of *Montipora aequituberculata*, whose colonies formed large, overlapping whorls cascading down the reef slope, as well as by codominance of large (>40 cm maximum diameter) colonies of *Pocillopora* and *Stylophora.* During 2002 surveys, Maragos recorded a total of 39 stony and one zoanthid soft species at Swains; additional surveys in 2004 increased this total to 42 stony and 2 non-stony coral species. This low species diversity, coupled with the abundance of large colonies and general homogeneity of sites surveyed, suggested a youthful coral community that had pioneered substrate following unknown catastrophic disturbances in the relatively recent past. Maragos interviewed residents of Swains in 2002 who revealed that the island was struck by a severe hurricane and coral bleaching in the early 1990s. Barring further catastrophic disturbance, the coral communities would be expected to develop increased species diversity and spatial variability as successional processes continued.

In the 2 years following the 2002 surveys, the reefs surrounding Swains Island appear to have experienced a number of disturbances of varying severity. During the 2004 surveys, the large, tiered plates of *Montipora aequituberculata* manifested varying degrees of fragmentation and scattering, with sites along the northern side of the island (SWA 6, SWA 8) showing the most extensive breakage and dispersal, followed in intensity by damage at those sites along the northeast exposure (SWA 7), southeast exposure (SWA 10, SWA 14), and western exposure (SWA 1, SWA 3, SWA 5). It is possible that much of this damage may be attributed to a hurricane that affected the high islands of American Samoa in early January 2004, although neither of the coral biologists had the opportunity to speak with the local residents about the degree to which this typhoon was experienced at Swains Island. The presence of numerous, robust *Pocillopora* colonies with sheared tips that were smoothed with fresh carbonate growth but were not yet epiphitized by algal growth, as well as unconsolidated rubble produced from branching corals (*Pocillopora, Stylophora)* that was lightly epiphitized by filamentous algae, also suggests a recent, intense disturbance such as a typhoon. Massive colonies and/or thick, shelving plates of *Porites* at depths greater than where belt transects were conducted appeared intact and undamaged. Not all of the apparent change in the reefs' appearance relative to 2 years ago can be attributed to recent damage, however. The preponderance of *Pocillopora* and *Stylophora* colonies showed a high amount of partial mortality accompanied by thick encrustations of coralline algae that could not have grown in the 6 weeks since the early January typhoon, which is most likely a manifestation of natural processes of coral senescence, overgrowth, and possibly response to recent coral bleaching. While sites along the northern exposure were heavily colonized by coralline algae, the fleshy algae *Microdictyon* assumed greater abundance along other exposures.

Relative to the visual appearance of the reef at other sites, the site (SWA 5) just south of the sole channel and landing to Swains appeared somewhat deteriorated, with evidence of marine debris (concrete blocks, rope, line), considerable coral rubble, little development of coralline algae, and filamentous algae visibly more abundant than at

other surveyed sites. The western half of the 2002 permanent transect at the site along with many of its intact corals were removed or destroyed from the site by the time of the 2004 surveys, likely by large waves. Moreover, the coral species *Porites rus*, a "weedy" species that has been associated with colonizing disturbed habitat, was very abundant at this site but not in evidence elsewhere. Analysis and comparison of 2002 and 2004 coral photoquadrats along the same alignment at the site will help to document the extent of changes in the coral community at site SWA-5.

In addition to the presumed recent typhoon damage, the reefs at Swains are currently experiencing a low level of coral bleaching in addition to *Acanthaster* predation. Bleaching was observed in *Montipora*, *Pocillopora*, S*tylophora*, and *Leptoseris*. *Acanthaster* and accompanying predation were most noticeable at depths of ~75 feet along the SE side of the island, where up to 10% of the coral appeared as white patches and *Acanthaster* were clearly visible. The combination of an apparently youthful coral community, a recent severe disturbance, present moderate disturbances in the form of bleaching and *Acanthaster* predation, remoteness from other reefs, and minimal proximate human damage render the reefs of Swains Island an interesting case study of ecological change.

Colonies belonging to 15 anthozoan genera were observed by Kenyon and counted within belt transects during quantitative surveys (Table 1). Members of the genera M*ontipora* and P*ocillopora* dominated the coral fauna in terms of number of colonies, with each genus contributing more than 10% of the total number of colonies. Visual estimates of percent live coral cover ranged from 25% at each of two sites along the southeast exposure (SWA 10, 14) to 70% at a site on the northeast side of the island (SWA 7); visual estimates of percent cover await comparison with values derived from computer-assisted quantitative analysis of videotapes recorded along transect lines. A total of 1507 coral colonies (of which 1503 were scleractinians) were counted within a total survey area of 392 m^2, for an average colony density of 3.8 coral colonies/m^2. Density values at individual sites ranged from 2.1/m^2 at site SWA-10 to 13.3/m^2 at a site along the northern side (SWA-8). Generic diversity values followed patterns similar to those for colony density, with the lowest generic diversity at SWA-10, and the highest generic diversities observed at SWA-8. Inspection of a histogram showing the size class distribution of anthozoan colonies counted and classified within belt transects (Fig. 2) shows that the majority (51.4 %) of colonies occur in the 20–40-cm size class, while 34.6% of the colonies measure < 20 cm in maximum diameter. These values stand in contrast to the size class distribution of colonies classified within belt transects in the Manu'a Group during OES 04-02, in which 81.0% and 88.0% of the coral colonies at Ta'u and Ofu/Olosega, respectively, measured less than 20 cm maximum diameter (Figs. 3 and 4).

Table 1. Number of corals (Class Anthozoa and Hydrozoa) reported at the REA sites at Swains Island by Kenyon during February 2004 surveys

	Swains	
coral genera	**# of corals**	**Percent of total**
Acanthastrea	1	0.1%
Acropora	2	0.1%

coral genera	Swains	
	# of corals	Percent of total
Astreopora	0	0.0%
Coscinaraea	5	0.3%
Cyphastrea	0	0.0%
Diploastrea	0	0.0%
Echinophyllia	0	0.0%
Echinopora	0	0.0%
Favia	15	1.0%
Favites	0	0.0%
Fungia	26	1.7%
Galaxea	0	0.0%
Gardineroseris	0	0.0%
Goniastrea	0	0.0%
GonioporaAlveopora	0	0.0%
Heliopora	3	0.2%
Hydnophora	1	0.1%
Leptastrea	0	0.0%
Leptoseris/Pachyseris	29	1.9%
Lobophyllia/Symphyllia	0	0.0%
Merulina/Scapophyllia	0	0.0%
Millepora	0	0.0%
Montastrea	0	0.0%
Montipora	365	**24.2%**
Oulophyllia	0	0.0%
Palythoa/Zoanthus	1	0.1%
Pavona	2	0.1%
Platygyra/Leptoria	0	0.0%
Pocillopora	862	**57.2%**
Porites	78	5.2%
Psammacora	29	1.9%
Sandalolitha	0	0.0%
Sarcophyton	0	0.0%
Seriatopora	0	0.0%
Sinularia/Lobophytum	0	0.0%
Stylaster/Distichopora	0	0.0%
Stylophora	88	5.8%
Turbinaria	0	0.0%
Total area surveyed	392m^2	
Total # colonies:	1507	

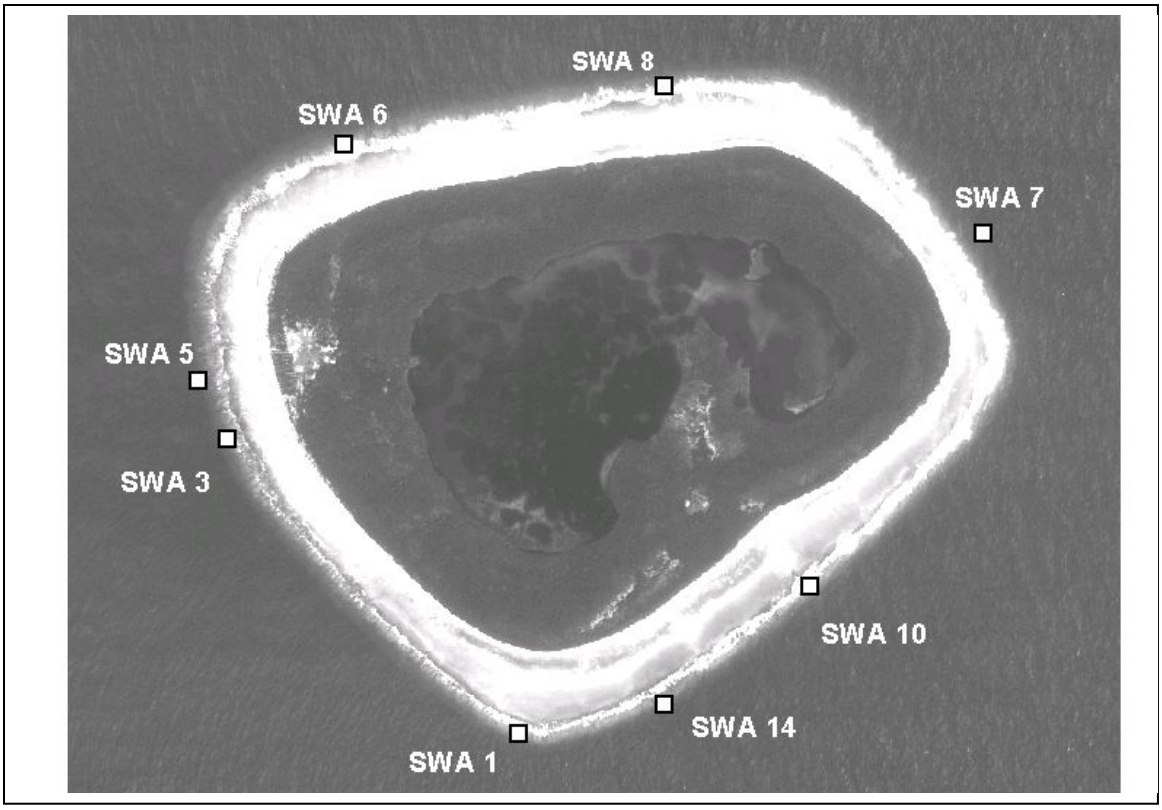

Figure 1. Location of coral benthic survey sites at Swains Island, February 2004

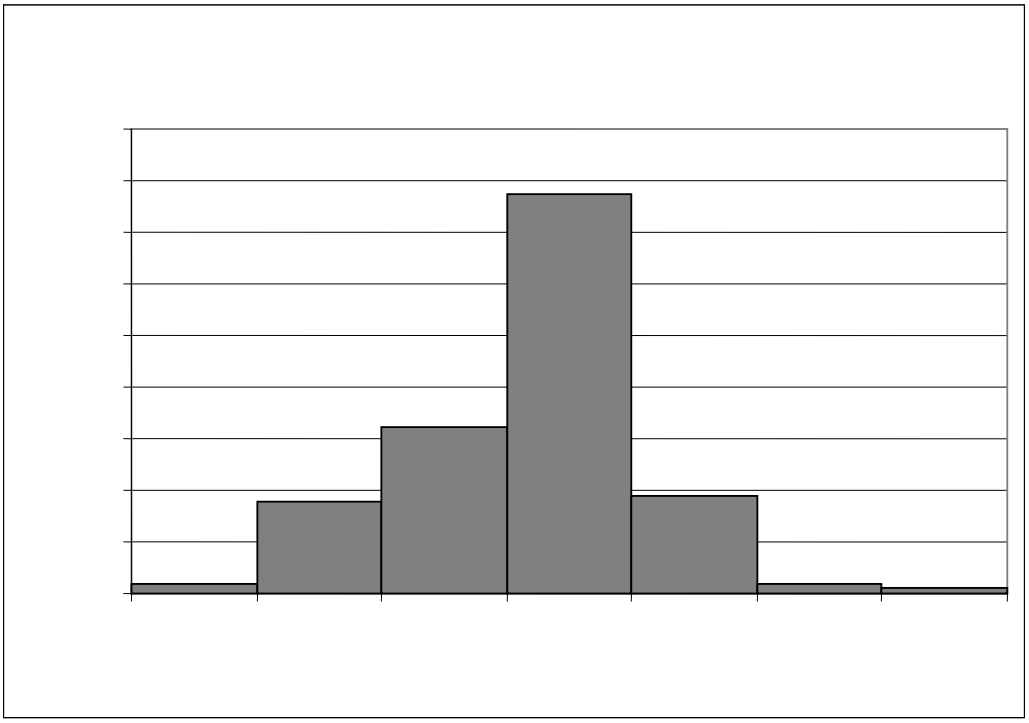
Figure 2. Size class distribution of 1503 scleractinian corals tallied and classified by Kenyon within belt transects at eight sites at Swains Island, American Samoa, February 2004

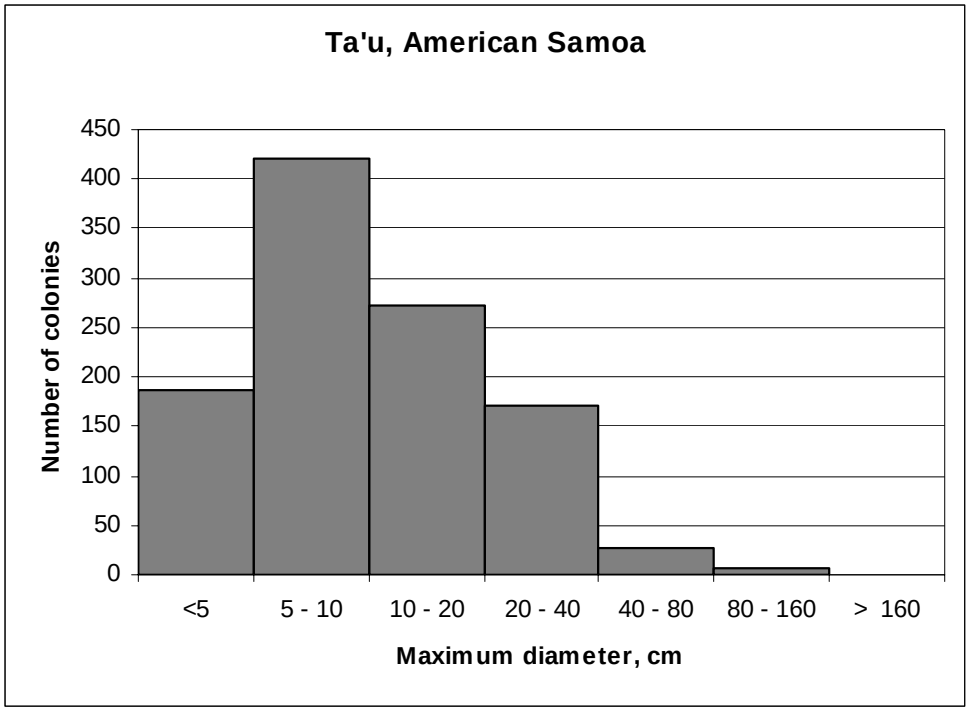

Figure 3. Size class distribution of 1085 scleractinian corals tallied and classified by Kenyon within belt transects at eight sites at Ta'u, American Samoa, February 2004

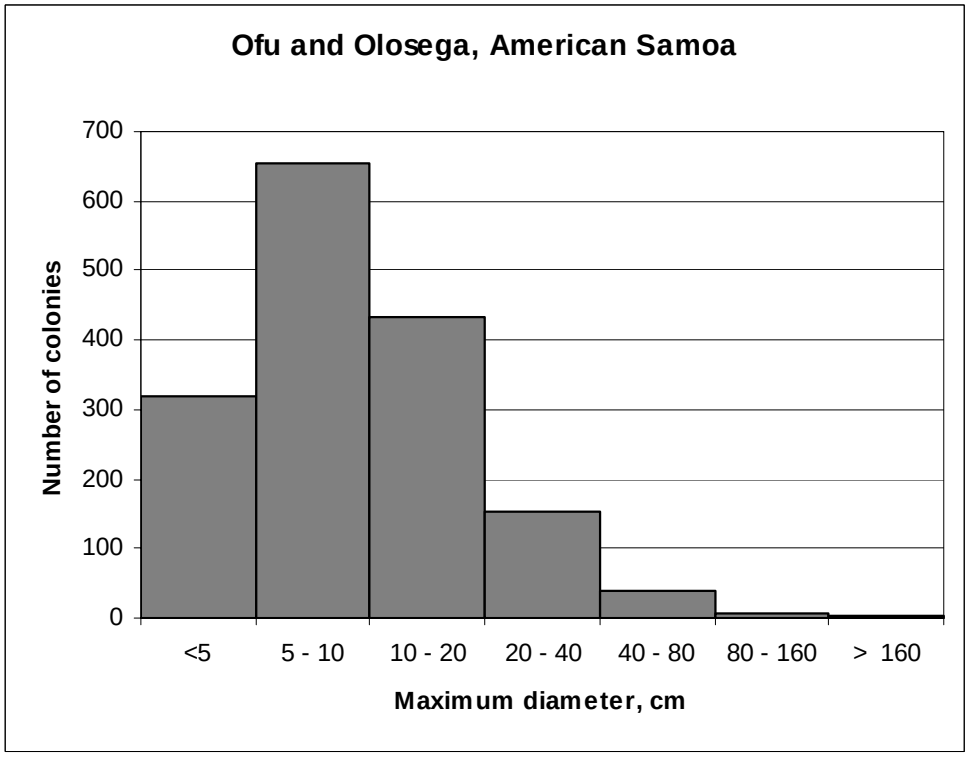

Figure 4. Size class distribution of 1607 scleractinian corals tallied and classified by Kenyon within belt transects at eight sites at Ofu and Olosega, American Samoa, February 2004

Tutu'ila and adjacent reefs

Tutu'ila, Taiema Bank, and Aunu'u

In a counter-clockwise direction, the 22 REA sites surveyed in 2004 around Tutu'ila (Fig. 5) included Taiema Bank (TUT-15), 3 km south of Pago Pago Harbor; one site off A'ua in Pago Harbor (TUT-16); three sites along the SE coast of Tutu'ila, off west Aunu'u (TUT-16), Lauli'ifou (TUT-1), and Faga'itua Bay (TUT-2): one site off the east end at Cape Matatula (TUT-17); three sites off the eastern half of the north coast at Maseusi (TUT-4), Masefau (TUT-5) and Afono (TUT-14); four more sites off the western half of the north coast of Tutu'ila at Fagasa Bay (TUT-19), Muliulu Point (TUT-13), A'asu (Massacre Bay; TUT- 12), and Tafou Cove TUT-18); two sites off the northwest coast at Aoluau Bay (TUT-8) and Poloa (TUT-7); two sites off the southwest coast at Amanave (TUT-6) and Leone Bay (TUT-23); two sites off the southern peninsula at Fagatele Bay National Marine Sanctuary (TUT-22) and Larsen's Bay (TUT-11); and three more sites off the south central coast at Fagagogo (TUT-21), the airport runway at Avatele (TUT-9), and the reef fronting the road to Nu'uuli (TUT-10). Additionally, a brief snorkel survey was accomplished off the tip of Pola Rock on the north coast. Maragos accomplished surveys at all sites except TUT-8 that was surveyed by Kenyon but not reported here.

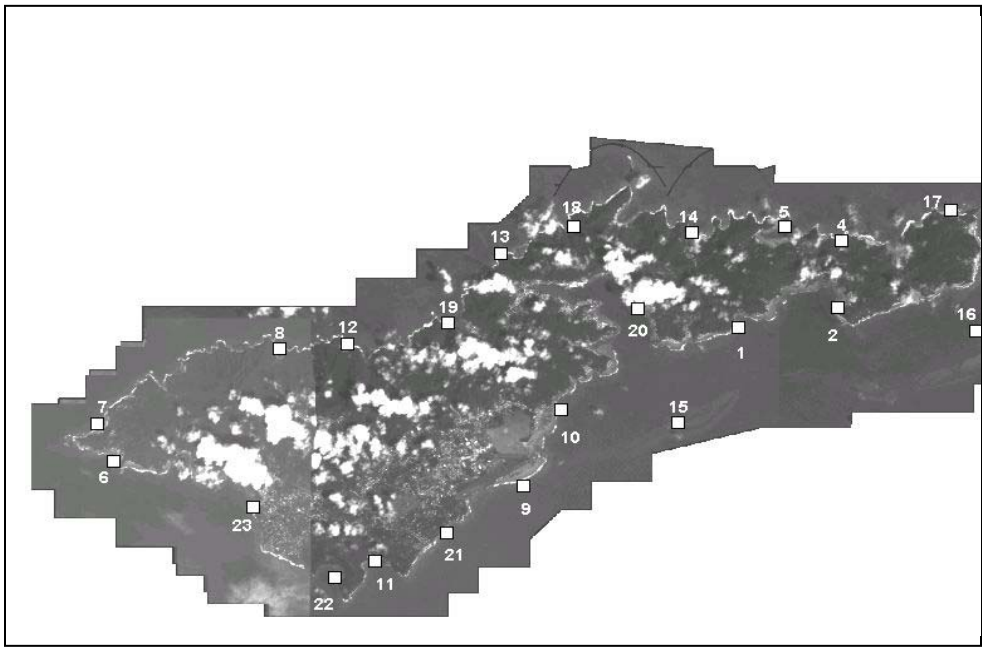

Figure 5. Location of coral benthic survey sites around Tutuila and adjacent reefs, February 2004

Coral diversity and abundance off Tutu'ila and adjacent reefs

Several major coral surveys have been accomplished off Tutu'ila over the past 85 years (Mayer 1918, several by Birkeland et al. beginning in 1978, Maragos et al.1994; Mundy 1995, and others). More than 250 species of stony corals have been reported from Tutu'ila which has much higher levels of coral diversity compared to the remaining and much smaller islands and reefs in American Samoa, including Swains reported above. The 2004 REA studies at Tutu'ila focused primarily on population counts along the first two REA transects rather than a more complete inventory of species. Table 2 summarizes the relative abundance of 5,862 corals belonging to genera of anthozoan and hydrozoan corals that were counted on the Maragos transects. Approximately 40 genera were reported, including several non-stony corals. Consistently, the most numerous corals in descending order belong to species of *Montipora, Porites, Sinularia/Cladiella, Pavona, Montastrea, Pocillopora, Leptastrea,* and *Acropora.* Other genera were locally abundant especially *Lobophyllia* at TUT-9, *Echinopora* at TUT-6, *Astreopora* at TUT-13 and TUT-9, and *Millepora* at the snorkeling site off Pola Rock (north coast). There was considerable spatial heterogeneity within many sites and even between adjacent transects. For example, one 25-m transect at TUT-6 surveyed by Kenyon had abundant *Merulina* patches, but the coral was nearly absent from the adjacent Maragos 25-m transect.

Geographic trends in coral abundance and distribution off Tutu'ila and adjacent reefs

Generic richness along the transects varied from a high of 22-23 coral genera at several east to southwest facing REA sites (TUT-16, -21, -17, -4, -10, -20, and -6); one was the A'ua reef inside nutrient-subsidized Pago Pago Harbor (TUT-21) that was supporting a few genera not common elsewhere. Generic richness of corals was lower, ranging from 7 to 18 genera, at several north and northwest facing sites (TUT-5, -14, -18, -19, -12, and -7). Similar patterns applied to coral frequency (number of corals per m^2) at the 2004 REA sites: the highest frequency values of 10 to 12.4 were at southeast facing (TUT-9, -10) and southwest facing (TUT-15, -16) sites. The lowest coral frequency values (1.2 to 2 corals/ m^2) were reported at north facing sites (TUT-4, -12, -13) and inside the harbor at TUT-20. During our surveys, wave energy and suspended sediments were high off most north and northwest facing sites.

Although time did not permit computations of mean coral diameters at each site, inspection of the size distribution data reveal that most large, mature coral colonies were located at sites facing to the southwest (TUT-17, -16, -22, -23, -6), south (TUT-1, -11), and southeast (TUT-10, -). Only one site facing to the north showed abundant large coral colonies (TUT-12).

Coral monitoring to document changes in reef condition over time

Coral REA protocols were modified after the earlier 2002 survey to collect quantitative data, especially on coral cover, size class distribution, coral frequency, and diversity. Both Kenyon and Maragos tested prototypes of the new methodology at several Tutu'ila sites during the 2002 surveys. The 2004 surveys provided an opportunity to evaluate the changes in coral population parameters at the earlier prototype sites.

However, only one of the three 2002 Maragos sites (TUT-6) was resurveyed in 2004. Maragos was not able to dive at one (TUT-8) and another (TUT-7) was repositioned in a habitat different from that of the 2002 survey, rendering nonvalid comparisons.

Table 3 provides the preliminary findings and comparison of 2002 and 2004 coral population data at Amanave (TUT-6). The results show a slight decline in coral populations. However, the 2004 transects at the site were not in the same type of coral community as the 2002 transects, and thus the comparison is inconclusive. Several large corals and genera of the 2002 survey were missing from the 2004 survey and vice versa. As noted earlier, there was considerable spatial heterogeneity observed at the site in 2004, and this appears to be the most likely explanation for the disparities in the preliminary results.

Future REA surveys to document changes in coral populations over time will need to address this concern. One option, accomplishing more transect surveys at each site, is not feasible given the great demand for the vessel to cover many tasks at many sites. The other option is to insure that resurveys are positioned more closely along the same starting points and alignments, perhaps using compass bearings for the alignment and placing a large visible permanent marker at the beginning and possibly another at the end transect points at each site. Although the fish team necessarily enters the water first, transect site selection decisions in the future will need to emphasize relocation of the same sites and habitats for meaningful time series comparisons for all REA teams. In some cases heavy wave action prevented teams from resurveying the same sites.

Is coral health declining on the reefs of Tutu'ila?

Although corals populations observed at nine sites off Tutu'ila in 2002 showed dramatic recovery since the 1991-92 American Coral Reef Inventory (Maragos et al. 1994), our 2004 observations show evidence of recent and midterm coral decline. Sediment may be causing decline of corals at three previously healthy sites (TUT-6, -7, -23). Recent hurricane damage (broken coral) was observed at northern sites. The number of new coral recruits at some REA sites seemed low, especially at sites with high sediments in suspension. Evidence of coral disease was observed at sites close to Pago Pago Harbor. The top of the offshore Taiema Bank showed abundant recruits but few mature colonies. Terrigenous soil erosion, especially after large rainstorms may be depositing sediments on the reefs, including those off the north coast. Possible effluents and refuse was evident near the Muliulu Point site (TUT-13), and clothing was snagged on corals near several villages. These issues may be worthy of future research to document their effects and instigate a public education campaign to improve solid waste disposal and soil conservation on the steep slopes that characterize much of Tutu'ila.

Coral populations at some sites appeared healthy or fully recovered from hurricane and coral bleaching damage of the early 1990s, including Fagatele Bay (TUT-22) and west Aunu'u Reef (TUT-16).

Table 2 Abundance of major coral taxa at REA sites around Tutu'ila, February 2004, expressed as numbers of corals and percentage of the total number of corals. As in Maragos (2004). Data combined from 20 Tutu'ila, one Taiema Banks, and Aunu'u Island sites.

Coral taxa	Number of corals	Percent of total
Acanthastrea	7	0.1
Acropora	242	4.1
Astreopora	124	2.1
Coscinaraea	45	0.8
Cyphastrea	13	0.2
Diploastrea	6	0.1
Echinophyllia/Oxypora	24	0.4
Echinopora	84	1.4
Favia	108	1.8
Favites	26	0.4
Fungia/Cycloseris	104	1.8
Galaxea	141	2.4
Goniastrea	32	0.5
Goniopora/Alveopora	11	0.2
Hydnophora	64	1.1
Leptastrea	277	4.7
Leptoseris	68	1.2
Lobophyllia/Symphyllia	180	3.1
*Lobophytum/Sarcophyton**	18	0.3
Merulina	1	0.02
Millepora	27	0.5
Montastrea	412	7
Montipora	1396	23.8
Mycedium	2	0.03
Pachyseris	5	0.1
*Palythoa**	43	0.7
Pavona	589	10
Platygyra/Leptoria	37	0.6
Plesiastrea	1	0.02
Pocillopora	336	5.7
Porites	698	11.9
Psammocora	48	0.8
Sandalolitha	6	0.1
Scapophyllia	3	0.05
*Sinularia/Cladiella**	675	11.5
Stylocoeniella	1	0.02
Stylophora	4	0.97
Tubastraea	1	0.02

Coral taxa	Number of corals	Percent of total
Tubrbinaria	1	0.02
others	2	0.03

total corals counted: 5862. Total transect area: 1360 m2
non-stony corals dennoted with asterisk (*)

Table 3. Comparison of 2002 and 2004 coral populations at TUT-6 (Amanave). Numbers are corals censused within a 50 m^2 transect Area during each REA. Data from Maragos 2002 and 2004

A. Number of all corals for each size class

	2002	2004
1-5 cm	18	5
6-10 cm	6	21
11-20 cm	75	22
21-40 cm	121	47
41-80 cm	76	104
81-160 cm	32	34
> 160 cm	1	19
totals	329	252

B. Number of all corals for each taxon (genera & Fam. Faviidae)

	2002	2004
Acropora	31	14
Astreopora	2	0
Coscinaraea	2	3
Echinophyllia	1	0
Family Faviidae	113	95
FungiaCycloseris	2	2
Galaxea	0	1
Leptoseris	0	1
Merulina	8	1
Montipora	86	65
Palythoa	0	1
Pavona	17	7
Pocillopora	30	6
Porites	30	26
Sarcophyton	7	1
Scapophyllia	0	1

Appendix C: **Algae Rapid Ecological Assessment (REA) Team Activity Report** (*Kimberly Page*)

Manu`a Islands
Algal Highlights:

- A total of 16 sites were surveyed for quantitative algal data at the Manua Islands:9 at Ta`u, 4 at Olosega, and 3 at Ofu.
- Crustose coralline, turf algae and an encrusting *Lobophora* sp. were the most common algae in the photoquads at all three islands.
- A diminutive species of *Laurencia* was common at Olosega.
- *Peysonnelia* sp. was very common at Ofu.

Site Descriptions:

Ta`u Island
TAU-7 2/4/04
This site was on the eastern side of the island with depths ranging from 38 to 42 feet. This site was a gentle reef slope with high sand and sediment. Crustose coralline algae as well as turf algae were the most abundant in the photoquadrats. *Halimeda* sp., a blue-green, and *Peysonnelia* sp. were seen as well in the photoquadrats. During the random swim a *Microdictyon* sp. was found as well.

TAU-2 2/4/04
This site was on the eastern side of the southern bight. This reef had a gentle slope to approximately 50 feet where it dropped in a vertical wall to a greater depth. The sample depth on the top of the reef ranged from 37 to 45 feet. Crustose coralline algae, turf algae, blue-green, *Halimeda* sp., *Haloplegma* sp., *Chlorodesmis* sp., and a gelid were found seen in the photoquadrats. *Peysonnelia* sp. and *Chrysemenia* sp. were found during the random swim.

TAU-8 2/4/04
This site was on the western side of the southern bight. This site was characterized by premature spur and groove formations. Long stretches of reef with small sand channels and very little relief were seen. Part of the reef looked as if it had been scraped clean with very little coral while the next part seemed to have higher coral abundance. Turf algae, blue-green algae, *Dictyosphaeria versluysii*, *Lobophora* sp., and *Halimeda* sp. were seen in the photoquadrats. *Chlorodesmis* sp. was found during the random swim.

TAU-4 2/5/04
This site was on the North east side of Ta`u near a road. This site had poor visibility with depths ranging from 40 to 45 feet. The first transect was characterized by the presence of large smooth rocks covered in turf algae while the second transect had more coral cover. Turf algae, crustose coralline algae, and *Neomeris* sp. were found in the photoquadrat area. During the random swim, *Chlorodesmis* sp., *Halimeda* spp., blue-green algae, and a gelid species were also found.

TAU-5 2/5/04
This site was on the northwest side of Ta`u Island. The reef was dominated by turf algae and crustose coralline pavement with small sand channels interspersed. Depths ranged from 40 to 45 feet. In addition to turf and crustose coralline algae, *Boodlea* sp., *Chlorodesmis* sp., *Lobophora* sp., *Galaxaura filamentosa*, and *Dictyosphaeria versluysii* were seen in the photoquads. During the random swim, *Padina* sp., *Haloplegma* sp., *Valonia* sp., and *Halimeda* spp. were also found.

TAU-9 2/5/04
This site was on the west side just south of the village in a very beautiful cove. The shallow area was surveyed qualitatively by snorkel and was characterized by calcium carbonate pavement with branched corallines and deep sand channels. The quantitative survey took place in depths ranging from 42 to 50 feet. This reef had high relief with many coral pinnacles. The benthos was primarily covered with crustose coralline algae and turf. There were many more fish (herbivores and predators) at this site compared to others visited. In addition to turf and crustose coralline algae, blue-green algae, *Halimeda* sp., *Chlorodesmis* sp., *Lobophora* sp., *Neomeris* sp., were also seen in the photoquadrats. During the shallow snorkel, what might be *Porolithon onkodes, Amphiroa* sp., and *Callophycus* sp. were collected. During the deeper dive, what appears to be *Tydemania expeditionis*, *Actiontrichia* sp., *Haloplegma* sp., as well as a few species of *Halimeda* were collected during the random swim.

TAU 11 2/11/04
This site was on the northwest corner in front of Faleasao Village. The first transect had very little relief and was dominated by colorful Montiporids. The second transect was characterized by *Porites* bommies with hard silted substrate separating them. Turf algae and crustose coralline algae dominated the photoquadrat area. *Dictyosphaeria versluysii*, a red filamentous cyanobacteria, and *Haloplegma* sp. were also seen in the photoquadrats. *Gibsmithia* sp., *Amansia* sp., *Halimeda* sp., *Chlorodesmis* sp., *Caulerpa* sp., *Amphiroa* sp., and a gelid were also collected from this site.

TAU 12 2/11/04
This site was on the southwest corner of Ta`u Island with depths ranging from 45 to 50 feet. This site had high relief with large *Porites* bommies scattered among other mounds of reef substrate. Turf and crustose coralline algae were dominant in the photoquadrats. *Lobophora* sp., *Chlorodesmis* sp., *Peysonnelia* sp., *Halimeda* sp., *Tydemania* sp., *Actinotrichia* sp., *Liagora* sp., and blue-green algae were also seen in the photoquadrats. During the random swim, *Dictyosphaeria versluysii, Neomeris* sp., and *Amansia* sp. were collected.

Olosega Island

OLO1 2/6/04
This site was on the east side of Olosega Island. It was characterized by the presence of very large coral heads (largest I have ever seen) and other healthy corals cemented together with very clean (minimally epiphytatized) crustose coralline algae. The depths

of this site ranged from 37 to 45 feet, sloping into deeper water. In the photoquadrats crustose coralline algae was dominant while, turf algae, *Halimeda* sp., *Peysonnellia* sp., *Amphiroa* sp., and a blue-green algae were also seen. *Actinotrichia* sp., *Chlorodesmis* sp., *Dictyosphaeria versluysii*, and a *Wragelia* sp. were found during the random swim.

OLO4 2/6/04
This site was on the southwest side of Olosega Island directly off shore from the village of Olesega. This site had moderate relief with depths ranging from 40 to 44 feet and was characterized by crustose coralline knobs with diminutive coral species. Crustose coralline algae, an encrusting brown assumed to be a *Lobophora* sp., turf algae, blue-green algae, *Amphiroa* sp., *Halimeda* sp., and *Peysonnelia* sp. were seen in the photoquadrats. Additionally, *Jania* sp., *Chlorodesmis* sp., and other *Halimeda* spp. were found during the random swim.

OLO5 2/7/04
This site was off the old village of Sili on the northwest side of Olosega. This reef had high relief and dropped off to a sandy bottom at ~ 65 feet. The sampling depth ranged from 34 to 41 feet. Crustose coralline algae, *Halimeda* sp., turf algae, blue-green cyanobacteria, *Amphiroa* sp., *Dictyosphaeria versluysii*, *Actinotrichia* sp., and *Chlorodesmis* sp. were seen in the photoquadrats. During the random swim, Haloplegma sp., *Bryopsis* sp., *Gelidiopsis* sp., *Myriogramme* sp., and additional species of *Halimeda* were collected.

OLO 6 2/13/04
This site was on the southeast side of Olosega Island with depths ranging from 46 to 51 feet. This site had little relief and with silt covered crustose coralline and turf algae dominating. There was also a diminutive species of *Laurencia* that was common in all of the photoquadrats. In addition to these, *Neomeris* sp., *Lobophora* sp., *Portieria hornemanni*, *Dictyosphaeria versluysii*, and blue-green algae were seen in the photoquadrats. During the random swim, *Halimeda* spp., *Chlorodesmis* sp., *Bryopsis* sp., and *Peysonnelia* sp. were also collected.

Ofu Island

OFU6 2/7/04
This site was off the village of Ofu on the west side of the island. This site had very high relief and may have once been a site of very large coral colonies. It is now dominated by crustose coralline algae. In addition to crustose coralline algae, *Halimeda* sp., turf algae, *Haloplegma* sp., and *Dictyosphaeria versluysii* were found in the photoquadrats. A few species of branched coralline algae as well as blue-greens, *Bryopsis* sp. and *Myriogramme* sp. were collected during the random swim.

OFU7 2/7/04
This site was in the lagoon off the national park beach on Ofu Island. It required a swim through breaking waves and a walk on very shallow (6 inches) of water. Once in deeper water there were coral heads separated by sand and rubble. During this qualitative

assessment, *Caulerpa serrulata*, *Chlorodesmis* sp., *Laurencia* sp., *Halimeda* spp., *Haloplegma* sp., *Bryopsis* sp., and *Tydemania* sp. were collected.

OFU 2 2/13/04
This site was on the southwest side of Ofu Island near the runway. This site had medium to high relief with depths ranging from 39 to 50 feet. The reef was dominated by large dead coral mounds with a crustose coralline substrate covering. In addition to crustose coralline algae, turf algae, *Lobophora* sp., *Peysonnelia* sp., blue-green algae, *Halimeda* sp., *Haloplegma duperryi*, *Dictyosphaeria versluysii*, *Actinotrichia* sp.and *Carpopeltis* sp. were seen. During the random swim, *Botryocladia* sp. and a large branched *Halymenia* sp. were collected.

OFU 8 2/13/04
This site was on the west side of Ofu Island in between the two islands off from the village of Ofu. This site had very little relief and was dominated by Pocilloporids and encrusting corals as well as turf and crustose coralline algae. In addition to these, blue-green cyanobacteria, *Laurencia* sp., *Lobophora* sp., *Peysonnelia* sp., and *Halimeda* sp. were seen in the photoquadrats. During the random swim *Chlorodesmis* sp. was also collected.

Table 1: Algae of Manu`a Island. Bold numbers indicate the number of photoquadrats in which an alga occurred; italicized numbers indicate the alga's relative abundance (rank) in relation to other algae occurring in the same photoquadrat. Standard deviation of island averages are given in parentheses.

	Ta`u Island Site Averages	**Olosega Island Site Averages**	**Ofu Island Site Averages**
GREEN ALGAE			
Boodlea	**2.78** **(5.89)** *2.25* *(0.35)*		
Chlorodesmis	**4.63** **(6.05)** *3.00* *(0.82)*	**2.08** **(4.17)** *5.00*	
Dictyosphaeria	**4.63** **(8.45)** *2.44* *(0.77)*	**4.17** **(4.81)** *5.00* *(1.41)*	**11.11** **(12.73)** *3.83* *(1.18)*
Halimeda	**11.11** **(14.43)** *3.15* *(0.66)*	**20.83** **(17.35)** *3.33* *(0.58)*	**22.22** **(25.46)** *3.75* *(1.06)*
Neomeris	**2.78** **(5.89)** *3.25*	**2.08** **(4.17)** *4.00*	

	Ta`u Island Site Averages	Olosega Island Site Averages	Ofu Island Site Averages
	(0.35)		
Tydemania	**0.93** **(2.78)** *5.00*		
RED ALGAE			
Actinotrichia	**1.85** **(3.67)** *4.00* *(1.41)*		**2.78** **(4.81)** *5.00*
Amphiroa		**16.67** **(18.00)** *5.10* *(0.36)*	
Carpopeltis			**2.78** **(4.81)** *5.00*
Galaxaura	**0.93** **(2.78)** *3.00*		
gelid	**1.85** **(3.67)** *4.00* *(1.41)*		
Haloplegma	**1.85** **(3.67)** *3.00* *(0.00)*		**5.56** **(4.81)** *3.50* *(0.71)*
Laurencia/Chondrophycus		**20.83** **(41.67)** *3.90*	**11.11** **(19.25)** *4.00*
Liagora	**0.93** **(2.78)** *4.00*		
Peyssonnelia	**3.70** **(8.45)** *3.17* *(0.24)*	**10.42** **(15.77)** *2.63* *(0.88)*	**47.22** **(41.94)** *3.49* *(0.44)*
Portieria		**2.08** **(4.17)** *5.00*	
crustose coralline	**73.15** **(31.40)** *1.64* *(0.46)*	**100.00** **(0.00)** *1.21* *(0.28)*	**97.22** **(4.81)** *1.20* *(0.13)*

	Ta`u Island Site Averages	Olosega Island Site Averages	Ofu Island Site Averages
BROWN ALGAE			
Lobophora	**10.19** **(10.85)** *3.23* *(0.22)*	**33.33** **(35.36)** *2.80* *(0.35)*	**30.56** **(29.27)** *2.88* *(0.18)*
CYANO-PHYTEA	**14.81** **(13.68)** *2.93* *(0.36)*	**54.17** **(36.32)** *3.18* *(0.83)*	**30.56** **(20.97)** *3.39* *(1.27)*
TURF	**91.67** **(22.05)** *1.33* *(0.35)*	**83.33** **(11.79)** *1.95* *(0.50)*	**97.22** **(4.81)** *1.99* *(0.31)*

Rose Atoll

Algal Highlights:

- Twelve sites were surveyed, 10 in forereef habitat and 2 in lagoonal habitat.
- Rose atoll had a very high abundance of algae on the forereef regions.
- The east was dominated by very *Microdictyon* and branched coralline algae. However, the *Microdictyon* sp. was completely absent from the west side surveys and there was noticeably less branched coralline algae.
- Site ROS 7P was near the 1992 shipwreck and appeared to have a larger abundance of turf algae. There also seemed to be higher turbidity in the water column.
- Inside the pass at ROS24 there was a very high abundance of *Liagora* sp.

Site Descriptions:

ROS 1, 2, 3, 21 2/8/04- 2/9/04
Site 1 was on the northeast quadrant and sites 2, 3, and 4 were on the southeast quadrant. All four of these sites were forereef habitat and very similar to each other with depths ranging from 45 to 55 feet. Site 3 seemed to have higher coral cover (Pocillaporids) than the other two sites; however, they were all dominated by branched and crustose coralline algae. Blue-green cyanobacteria and *Microdictyon* sp. were also very abundant at the three sites. ROS2 had a very high abundance of *Caulerpa* sp. (possibly *C. cuppresoides*) compared to the other two sites; however, it was present at all sites. In addition, to the above *Dictyosphaeria versluysii*, *Halimeda* spp., *Valonia* sp., and *Lobophora* sp. were seen in the photoquadrats. During the random swims, multiple species of *Halimeda*, a very small filamentous *Caulerpa*, multiple blue-green species, as well as *Jania* sp. were collected.

ROS 4 and 22 2/9/04
Site 4 was on the southwest corner of the Rose Atoll and site 22 is on the northwest corner. These sites were also forereef habitat that was similar to the sites above with depths ranging from 40 to 50 feet. They differed in the complete absence of *Microdictyon* sp. and there was seemingly less branched coralline. There was still a dominance of crustose coralline algae and a dark brown/gray blue-green cyanobacteria that seen to be growing on what is thought to be an encrusting growth form of *Lobophora*. In addition to the these, *Halimeda* spp., turf algae, *Dictyosphaeria versluysii*, and *Dictyota* sp. were seen in the photoquadrats. During the random swim, *Caulerpa* sp.and a *Hypnea* sp. were also collected.

ROS 23 and 5 2/10/04
These sites were forereef sites on the southwest side of the atoll on either side of the 1992 shipwreck site. This habitat had higher coral cover than the other sides of the atoll dominated by Pocilloporids. There was also higher relief at these sites with depths ranging from 40 to 60 feet. There was a definite decrease in the presence of branched coralline that was seen on the east side as well as the continued absence of *Microdictyon* sp. for the west side. ROS 5 seemed to have a higher diversity of coral species than ROS 23. However they were similar in most respects. Crustose coralline, turf algae, an encrusting *Lobophora* sp. with a blue-green alga growing epiphytically, *Halimeda* sp., and branched coralline were seen in the photoquadrats. *Bryopsis* sp. and *Dictyota* sp. were seen commonly at RO5 in the photoquadrats but not at ROS 23. During the random swim additional *Halimeda* sp., as well as *Dictyosphaeria versluysii* were collected.

ROS 7P 2/10/04
This site was the closest site to the shipwreck. It was very similar to the site above with Pocilloporids dominating the coral; however, there was an increase of water turbidity with a lot of algal particulate matter in the water collum (*Bryopsis* sp. and blue-green cyanobacteria). There was also a noticeable increase in turf cover with less crustose coralline cover. In addition to these, blue-green cyanobacteria, *Lobophora* sp., *Bryopsis* sp., *Dictyota* sp., and *Halimeda* sp. were seen in the photoquadrats. Additional blue-greens and a gelid were found during the random swim.

ROS 6 2/11/04
This site was on the northwest side of the atoll near the pass. It was very similar to the other side on the west side of the atoll with Pocilloporids, crustose coralline, and an encrusting *Lobophora* sp. as the dominant substrates. In addition to these, *Halimeda* sp., *Dictyota* sp., *Bryopsis* sp., branched coralline algae, and turf algae were seen in the photoquadrats.

ROS 8 2/11/04
This was a single pinnacle just inside the pass on the north part of the lagoon. This site was nearly devoid of life at the survey depth (~30 feet) with the exception of blue-green cyanobacteria and a Spondolid? oyster. In shallower depths, *Galaxaura filamentosa* as well as *Halimeda* sp. were found.

ROS 9P 2/11/04
This site consisted of two pinnacles in the southwest corner of the lagoon adjacent to the CREWS buoy site. These pinnacles were characterized by high abundance of giant clams with a large *Porites* adjacent. There was a very interesting temperature regime with very warm water near the surface and cooler water at the bottom. There was very little algal abundance with only turf algae, blue-green algae, and crustose coralline algae occurring in the photoquadrats. *Bryopsis* sp. was found during the random swim.

ROS 24 2/11/04
This was a qualitative snorkel on the north backreef west of the pass with depths of about 4 feet. There were small coral heads and an amazing abundance of *Liagora* species. *Halimeda* sp., *Caulerpa* sp., and *Bryopsis* sp. were also found at this site. We should do a quantitative dive here.

Table 1: Algae of Rose Atoll. Bold numbers indicate the number of photoquadrats in which an alga occurred; italicized numbers indicate the alga's relative abundance (rank) in relation to other algae occurring in the same photoquadrat. Standard deviation of island averages are given in parentheses

	Island Average
GREEN ALGAE	
Bryopsis	**10.42** **(22.79)** *3.97* *(0.21)*
Caulerpa	**3.47** **(9.70)** *5.13* *(0.18)*
Dictyosphaeria	**16.67** **(24.87)** *5.82* *(0.40)*
Halimeda	**37.12** **(29.67)** *4.62* *(0.82)*
Microdictyon	**31.94** **(47.25)** *3.02* *(0.53)*
Valonia	**2.78** **(5.43)** *7.00* *(1.00)*
RED ALGAE	
Amphiroa	**0.69**

	Island Average
	(2.41) *7.00*
Galaxaura	**0.69** **(2.41)** *3.00*
Laurencia/Chondrophycus	**0.69** **(2.41)** *5.00*
Peyssonnelia	**2.08** **(7.22)** *5.67*
branched upright coralline	**45.83** **(41.51)** *2.83* *(1.00)*
crustose coralline	**86.11** **(31.05)** *1.59* *(0.50)*
BROWN ALGAE	
Dictyota	**4.86** **(8.30)** *3.96* *(1.20)*
Lobophora	**38.19** **(44.02)** *3.33* *(1.35)*
Stypopodium	**0.69** **(2.41)** *8.00*
CYANO- PHYTES	**62.50** **(28.54)** *3.33* *(1.17)*
TURF	**84.03** **(20.55)** *2.93* *(1.15)*

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Swains Island

Algal highlights:

- *Microdictyon* sp. and *Avrainvillea* sp. had high occurrence at all sites except for SWA 5P.
- Site SWA 5P was very unique with an abundance of *Galaxaura filamentosa* and no Microdictyon sp.
- *Liagora* sp. was found within the small lagoon.

SWA 6, 7, 8 2/15/04
These sites were on the north side of Swains Island (6 on the northwest, 7 and 8 on the northeast side). These sites were characterized by the abundance of live coral primarily Pocilloporids and Montiporids. The sites had medium relief with working depths of 40 to 60 feet sloping steeply to deeper depths. Crustose coralline algae, branched coralline algae, turf algae, cyanobacteria, *Avrainvillea* sp., *Microdictyon* sp., *Peysonnellia* sp., *Lobophora* sp., *Wrangelia* sp. and *Dictyosphaeria versluysii* were seen in the photoquadrats. During the random swim, *Halimeda* sp., *Dictyosphaeria cavernosa*, *Caulerpa serrulata*, and *Valonia* sp. were also collected.

SWA 10P, and 14
These sites were on the southeast facing side of Swains Island. These sites were very similar to the sites above with high coral cover primarily Pocilloporids and fragile plate Montiporids. However at these sites, there was more *Microdictyon* than at the other sites. It was the most dominant in many of the photoquadrats. In addition to *Microdictyon* sp., crustose coralline algae, turf algae, *Avrainvillea* sp., a red filamentous cyanophyte, *Dictyosphaeria versluysii*, branched coralline algae, *Halimeda* sp., and *Peysonnellia* sp. were seen in the photoquadrats.

SWA 1 02/17/04
This site was on the southwest corner of Swains. This site was very similar to sites 10 P and 14 with Pocilloporids and Montiporids dominating and with a high abundance of *Microdictyon* sp. Crustose coralline, turf algae, branched coralline algae, *Avrainvillea* sp., red filamentous cyanobacteria, *Dictyosphaeria versluysii*, and *Peysonnellia* sp. were also seen on the photoquadrats. *Halimeda* sp. was collected during the random swim.

SWA 3 02/17/04
This site was on the central west side of Swains Island, south of the pass. It appeared to have been recently damaged by a storm causing the site to have an abundance of broken corals that were found in depths ranging from 40 to 50 ft. Like the other sites, this site was dominated by Pocilloporids and Montiporids. There was less *Microdictyon* sp. However, it was present in the photoquadrata along with crustose coralline, *Avrainvillea* sp., *Lobophora* sp., and branched coralline. *Caulerpa serulata* and *Halimeda* sp. were seen during the random swim.

SWA 5P 02/17/04
This site was on the central west side of Swains Island directly outside of the boat pass. This site was different from the other sites visited with more *Porites* and more turf algae. There was also an abundance of *Galaxaura filamentosa* which was not seen at the previous sites. *Dictyota* sp., *Avrainvillea* sp., *Jania* sp., crustose coralline algae, cyano-bacteria, and *Caulerpa serrulata* were also seen in the photoquadrats. *Halimeda* was found during the random swim.

SWA 15 2/17/04
This site was inside the pass near the village of Swains Island. This area consisted of carbonate pavement with silt covering. Turf algae, *Caulerpa serrulata*, and a *Liagora* sp. were collected. The site was very shallow, 2-4 feet deep, and the presence of waves at high tide made it impossible to take photos.

Table 1: Algae of Swains Island. Bold numbers indicate the number of photoquadrats in which an alga occurred; italicized numbers indicate the alga's relative abundance (rank with 1 as the highest) in relation to other algae occurring in the same photoquadrat. Standard deviations of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	SW A 8	**SW A 6**	**SW A 7**	**SW A 10P**	**SW A 14**	**SW A 1**	**SW A 3**	**SW A 5P**	**Island Average**
Avrainvillea	**100.0**	**91.67**	**75.00**	**41.67**	**83.33**	**100.0**	**66.67**	**33.33**	**73.96 (25.37)**
	3.50	*4.27*	*3.44*	*4.40*	*4.00*	*4.50*	*3.38*	*3.75*	*3.91 (0.45)*
Caulerpa	* **0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.33** *2.00*	**1.04 (2.95)** *2.00*
Dictyosphaeria	**33.33** *4.50*	**8.33** *6.00*	**16.67** *4.50*	**25.00** *5.33*	**16.67** *5.00*	**8.33** *5.00*	**0.00**	**0.00**	**13.54 (11.73)** *5.06 (0.56)*
Halimeda	**0.00**	**0.00**	**0.00**	* **0.00**	**8.33** *6.00*	* **0.00**	* **0.00**	**0.00**	**1.04 (2.95)** *6.00*
Microdictyon	**66.67** *4.13*	**8.33** *3.00*	**58.33** *2.14*	**100.0** *1.58*	**91.67** *1.27*	**83.33** *3.10*	**58.33** *3.86*	**0.00**	**58.33 (36.73)** *2.73 (1.10)*
Galaxaura	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.33** *3.50*	**4.17 (11.79)** *3.50*
Jania	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**16.67** *4.50*	**2.08 (5.89)** *4.50*

	SWA 8	SWA 6	SWA 7	SWA 10P	SWA 14	SWA 1	SWA 3	SWA 5P	Island Average
Peyssonnelia	**0.00**	**33.33**	**16.67**	**16.67**	**8.33**	**8.33**	**25.00**	**0.00**	**13.54 (11.73)**
		2.50	*2.00*	*4.00*	*5.00*	*2.00*	*4.00*		*3.25 (1.25)*
Wrangelia	**8.33**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.04 (2.95)**
	6.00								*6.00*
branched upright coralline	**75.00**	**0.00**	**25.00**	**25.00**	**33.33**	**58.33**	**41.67**	**0.00**	**32.29 (26.14)**
	2.00		*1.33*	*3.33*	*4.25*	*4.57*	*2.60*		*3.01 (1.27)*
crustose coralline	**91.67**	**91.67**	**91.67**	**83.33**	**100.0**	**100.0**	**100.0**	**91.67**	**93.75 (5.89)**
	1.09	*1.55*	*1.73*	*2.00*	*1.83*	*1.33*	*1.33*	*2.09*	*1.62 (0.35)*
Dictyota	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**50.00**	**6.25 (17.68)**
								4.17	*4.17*
Lobophora	**0.00**	**33.33**	**0.00**	**0.00**	**0.00**	**0.00**	**8.33**	**8.33**	**6.25 (11.57)**
		2.75					*4.00*	*3.00*	*3.25 (0.66)*
Blue-green	**8.33**	**58.33**	**50.00**	**50.00**	**58.33**	**100.0**	**0.00**	**50.00**	**46.88 (31.16)**
	6.00	*3.57*	*3.50*	*3.67*	*4.29*	*4.25*		*2.83*	*4.02 (1.00)*
turf	**50.00**	**91.67**	**91.67**	**91.67**	**91.67**	**91.67**	**83.33**	**91.67**	**85.42 (14.60)**
	2.33	*2.00*	*3.09*	*2.64*	*3.45*	*2.82*	*2.00*	*1.27*	*2.45 (0.70)*

Tutuila

Algal Highlights

- Twenty-two sites (264 photoquadrats) around the island of Tutuila were quantitatively assessed for algal abundance for the first time.
- Thirty-six genera of algae were found on the island of Tutuila (11 from Chlorophyta, 23 from Rhodophyta, and 2 from Phaeophyta).
- There was a high abundance of gelatinous plants from the order Gigartinales along the north and west facing coast.
- There was a high abundance of *Peyssonnelia* spp. along the south coast.
- There was no *Microdictyon* sp. seen or collected from the island of Tutuila.

Site Descriptions

TUT 15 2/18/04 Taiema Bank
This site was a bank located directly south of the Pago Pago Harbor. It had very little relief with depths ranging from 35 to 41 feet. Also, the site consisted of a scoured reef with turf algae, crustose coralline algae, and encrusting corals being the dominant substrate. There were small trenches where rocks covered in turf algae had accumulated. In addition to turf algae and crustose coralline algae, an encrusting *Lobophora* sp., *Dictyosphaeria versluysii*, and cyanobacteria were seen in the photoquadrats. *Chondrophycus* sp. was found during the random swim.

TUT 16 2/19/04 Aunu`u Island
This site was on the southwest side of Aunu`u Island (small island on the east side of Tutuila). This was a very beautiful site with a high diversity of coral. It had medium relief, with a survey depth of 38 to 46 feet, that sloped deeper to ~90 feet. There were large gorgonians at the bottom of the slope. Crustose coralline algae, turf algae, red filamentous cyanobacteria, *Halimeda* sp., *Peyssonnelia* sp., *Dictyosphaeria versluysii*, *Lobophora* sp., and a large species of *Amphiroa* were seen in the photoquadrats. *Tricleocarpa* sp., *Haloplegma* sp., *Neomeris* sp. and *Gibsmithia* sp. were seen during the random swim.

TUT 17 2/19/04 Matatula
This site was on the northeast side of Tutuila off a small village area called Matatula and near the NOAA weather station. This site was characterized by a predominately crustose coralline reef segmented by large channels. The top of the reef was at ~30 feet and sloped to ~100 feet. Depths sampled ranged from 39 to 53 feet. Crustose coralline algae, turf algae, Halimeda sp., Neomeris sp., red filamentous cyanobacteria, Liagora sp., Peyssonnelia sp., a flat red dichotomously branched plant possibly *Corynocystis prostrata*, *Dictyota* sp., and *Amphiroa* sp. were seen in the photoquadrats. During the random swim, *Dictyosphaeria versluysii*, *Galaxaura filamentosa*, *Liagora* sp., *Cheilosporum* sp., *Portieria hornemanni*, and *Bryopsis* sp. were seen.

TUT 4 2/19/04 Fasausi
This site was on the northeast side of Tutuila in a bay off the village of Fasausi. This site was characterized by the abundance of very large *Porites* coral heads and the abundance of gooey red algae. In the photoquadrats, turf algae, crustose coralline algae, *Lobophora* sp., *Halimeda* sp., *Acrosymphyton* sp., *Predeae lacinosa*, *Peyssonnelia* sp., *Amphiroa* sp., and red filamentous cyanobacteria were seen. During the random swim, *Dudresnaya* sp., *Cheilosporum* sp., *Valonia* sp., *Portieria hornemanni*, and *Galaxaura filmentosa* were seen.

TUT 5 2/20/04 Masafau Bay
This site was on the north side of Tutuila in Masafau Bay. The site was dominated by plate/finger forming Montiporids. The reef sloped from ~15 feet to ~65 feet, sampling depths ranged from 37 to 50 ft. This site was striking because of the high abundance of "gooey reds." What is believed to be a species of *Dudresnaya* was covering many areas.

There was also a very high diversity of macrophytes at this site. In the photoquadrats, crustose coralline algae, turf algae, blue-green algae, *Amphiroa* sp., *Peyssonnelia* sp., *Actinotrichia* sp., *Dudresnaya* sp., *Acrosymphyton* sp., *Chlorodesmis* sp., *Galaxaura* sp., *Lobophora* sp., *Halimeda* sp. and *Gelidiopsis* sp. were seen. During the random swim, a flat *Galaxaura* sp., *Tricleocarpa* sp., *Tydemania* sp., *Caulerpa racemosa*, *Titanophora* sp., *Ventricaria ventricosa*, and *Haloplegma duperreyi* were seen.

TUT 14 2/20/04 Afono Bay
This site was on also on the north side of Tutuila in Afono Bay. It was similar to TUT 5 however with a higher abundance of *Porites* and Halimeda. Working depths ranged from 40 to 50 feet. There was less of the *Dudresnaya* here and more of a finely branched gelatinous red alga (possibly *Acrosymphyton* sp.). In the photoquadrats, turf algae, crustose coralline algae, *Halimeda* sp., *Acrosymphyton* sp., *Amphiroa* sp., Ventricaria *ventricosa*, *Peyssonnelia* sp., and *Tydemania* sp. were seen. During the random swim, *Titanophora* sp., *Bryopsis* sp., *Predaea* sp., and *Corynocystis prostrata* were collected.

TUT 18 2/20/04 Tafou Cove
This site was on the north side west of the cock's comb rock island in Tafou Cove. This site was similar to TUT 14 with large *Porites* heads and a large coralimorph, however, with no *Halimeda*. There was a striking abundance of the finely branched gooey red alga (tentatively identified as *Acrosymphyton* sp.). In the photoquadrats, crustose coralline algae, turf algae, *Acrosymphtyon* sp., *Dictyota* sp., cyanobacteria, *Bryopsis* sp., *Amphiroa* sp., *Chlorodesmis* sp., *Titanophora* sp., and *Peyssonnelia* sp. were seen. During the random swim, *Neomeris* sp., *Corynosystis prostrata*, *Liagora* sp., and *Condrophycus* sp.were found.

TUT 13 2/21/04
This site was on the central north side of Tutuila. It was an exposed reef at the bottom of a basaltic cliff. The site was scoured and had a great amount of surge. There was a large amount of sponges. Turf algae, *Lobophora* sp., Crustose coralline algae, blue-green cyanobacteria, *Peyssonnelia* sp., and *Jania* sp., were seen in the photoquadrats. *Acrosymphyton* was seen floating throughout the water column. *Neomeris* sp., *Actinotrichia* sp., and *Dictyosphaeria versluysii* were also found during the random swim.

TUT 19 2/21/04 Fagasa Bay
This site was on the west side of Fagasa Bay on the north side of Tutuila. This site had a high diversity of coral and algae; however, there was poor visibility and very strong surge. The reef sloped steeply and there were channels segmenting the reef. The depth sampled ranged from 41 to 50 feet. In the photoquadrats, crustose coralline algae, blue-green algae, *Acrosymphyton* sp., *Halimeda* sp., *Amphiroa* sp., *Peyssonnelia* sp., *Lobophora* sp., *Portieria hornemanni*, *Dictyota* sp., *Cheilosporum* sp., and a flat species of *Galaxaura* were seen. In addition, *Titanophora* sp., *Neomeris* sp., *Boodlea* sp., Gelidiopsis sp., *Liagora* spp., and *Bryopsis* sp. were found during the random swim.

TUT 12 2/21/04 Massacre Bay
This site was in Massacre Bay on the north side of Tutuila. The transects were placed on the east side of the bay because of the large incoming swell hitting the western side of the bay; however, the east side was a much less developed reef. The surveyed area had very little relief sloping down with depths ranging from 37 to 46 feet. There was very little coral, and the dominant substrate consisted of small rocks covered in a green alga similar to *Bryopsis* but called turf until the identification can be confirmed. In addition to turf algae, *Acrosymphyton* sp., *Halimeda* sp., *Liagora* sp., and *Neomeris* sp. were seen in the photoquadrats. The random swim incorporated the more developed reef region with very large *Porites* coral heads. *Dudresnaya* sp., *Gibsmithia hawaiiana*, *Cheilosporum* sp., *Haloplegma* sp., and *Peyssonnelia* sp. were found during this swim.

TUT 2 2/22/02 Fagaitua Bay
This site was on the southeast side of Tutuila in Fagaitua Bay. This site had a high amount of coral rubble at the sampled depths of 40 to 45 feet. The reef was more developed at shallower depths of 15 to 25 feet. Turf algae, *Galaxaura marginata*, *G. filamentosa*, *Amphiroa* sp., Cyanobacteria, *Caulerpa serrulata*, large plates of *Peysonnelia* sp., Halimeda sp., *Tricleocarpa* sp., crustose coralline algae, and *Dictyota* sp. were seen in the photoquadrats. During the random swim, *Cheilosporum* sp., *Haloplegma* sp., and *Gibsmithia* sp. were found.

TUT 1 2/22/04 Alega Bay
This site was on the reef off Tesa's bar in Alega Bay. This site was characterized by large Porites heads with a high abundance of Halimeda and soft corals. In addition to Halimeda, crustose coralline algae, turf algae, *Haloplegma* sp., *Peyssonnelia* sp., *Cheilosporum* sp., *Amphiroa* sp., *Actinotrichia* sp., and red cyanobacteria were seen in the photoquadrats. During the random swim, *Corynosystis prostrate* and other species of Halimeda were found.

TUT 20 2/22/04 Au`a
This site was off from the village of Au`a inside of Pago Pago Harbor. This site had a very high abundance and was dominated by *Peyssonnelia* spp. as well as other crustose coralline algae. In addition to these, turf algae and branched coralline were seen in the photoquadrats. *Halymenia* sp., *Bryopsis* sp., and *Gelidiopsis* sp. were seen during the random swim.

TUT 10 2/23/04
This site was on the south side of Tutuila west of Pago Harbor and east of the airport. The site had a very high abundance of "brain coral." The reef flat was at approximately 20 feet sloping down to ~80 feet. The working depths ranged from 38 to 47 feet. Crustose coralline algae, branched coralline algae, *Peyssonnelia* sp., *Cheilosporum* sp., turf algae, *Halimeda* sp., red cyanobacteria, *Amphiroa* sp., *Bryopsis* sp., and *Dictyota* sp. were seen in the photoquadrats. During the random swim, *Actinotrichia* sp., *Corynosystis prostrata*, and *Gelidiopsis* sp. were seen.

TUT 9 2/23/04
This site was on the south side of Tutuila right off from the airport. This site had high wave action and was characterized by high coral diversity with mostly encrusting corals and Pocilloporids. There was very little relief and the working depths ranged from 42 to 55 feet. Turf algae, crustose coralline algae, *Dictyosphaeria versluysii*, *Cheilosporum* sp., *Peyssonnelia* sp., red cyanobacteria, *Halimeda* sp., and *Actinotrichia* sp. were seen in the photoquadrats. During the random swim, *Chrysemenia* sp. and *Jania* sp. were also collected.

TUT 21 2/23/04
This site was on the south side of Tutuila west of the airport off from steep basaltic cliffs. This site had high relief with large coral mounds and appeared to experience high wave action with crustose coralline algae as the dominant substrate. In addition to crustose coralline, *Peyssonnelia* sp., turf algae, *Actinotrichia* sp., *Gelidiopsis* sp., *Halimeda* sp., *Cheilosporum* sp., *Amphiroa* sp., and red cyanobacteria were seen in the photoquadrats. During the random swim, *Dictyosphaeria versluysii*, *Halymenia* sp., *Gelidiopsis* sp., and an unknown red noncalcified blade were collected.

TUT 11 2/24/04 Larsen's Bay
This site was on the southwest side of Tutuila in Larsen's Bay. It was characterized by spur and groove formations with large sand channels separating the reef. This reef was highly developed and had high relief and high species diversity. Working depths ranged from 40 to 50 feet. In the photoquadrats, turf algae, *Dictyosphaeria versluysii*, crustose coralline algae, *Peyssonnelia* sp., *Galaxaura filamentosa*, *Cheilosporum* sp., red filamentous cyanobacteria, and *Gelidiopsis* sp. were seen. During the random swim, *Neomeris* sp., *Corynosystis prostrata*, *Chrlorodesmis* sp., and *Actinotrichia* sp. were collected.

TUT 22 2/24/04 Fagatele Bay
This site was on the southwest side of Tutuila in the National Marine Sanctuary at Fagatele Bay. We surveyed the east side of the bay where there was potential damage because of the recent hurricane. There were a few plate Acroporas that had been overturned which seemed to be the extent of the damage. The site was characterized by the abundance of *Acropora* spp.; both *A. cytherae* and *A. nobilis* were in high abundance. Working depth ranged from 40 to 50 feet. In the photoquadrats, turf algae, crustose coralline algae, red filamentous cyanobacteria, *Gelidiopsis* sp., *Amphiroa* sp., *Halimeda* sp., *Dictyosphaeria versluysii*, *Galaxaura filamentosa*, *Dictyota* sp., *Cheilosporum* sp., and *Peyssonnelia* sp. were seen. A species of *Valonia* was also found at this site.

Table 1: Site description of Fagatele Bay National Marine Sanctuary

	Percent occurnence in photoquadrats	*Average rank (1 highest)*	Other species collected
Green Algae			
Chlorodesmis	**8.33**	*2.00*	
Dictyosphaeria	**8.33**	*5.00*	
Halimeda	**66.67**	*3.63*	
Valonia			*
Red Algae			
Amphiroa	**75.00**	*4.11*	
Cheilosporum	**50.00**	*3.00*	
Galaxaura	**8.33**	*7.00*	
Gelidiopsis	**8.33**	*4.00*	
Peyssonnelia	**58.33**	*4.00*	
crustose coralline	**83.33**	*2.00*	
Brown Algae			
Dictyota	**8.33**	*4.00*	
Cyanophytes	**41.67**	*4.60*	
Turf	**91.67**	*1.64*	

TUT 23 2/24/04 Leone
This site was on the southwest side of Tutuila off from the village of Leone on the east side of the bay off from the old school house. This site had high relief and seemingly high diversity of coral. There was also a very high abundance of *Peyssonnelia* sp. that was forming plates around Monitporids. There was low visibility, likely from runoff from the village. Depths ranged from 30 to 45 feet. In the photoquadrats, turf algae, crustose coralline algae, *Cheilosporum* sp., red cyanobacteria, *Peyssonnelia* sp., and *Amphiroa* species. During the random swim, *Galaxaura marginata*, *Dudresnaya* sp., *Gelidiopsis* sp., *Halimeda* sp., and *Dictyosphaeria versluysii* were seen.

TUT 6 2/25/04 Amanave
This site was on the southwest corner of Tutuila off from Amanave Village. This area was protected and calm with survey depths between 35 and 40 feet. The reef was dominated by a thin upright plate of corals (*Turbinaria* sp.) arranged in a small spur and groove formation. Turf algae, crustose coralline algae, *Halimeda* sp., red cyanobacteria, *Peyssonnelia* sp., *Bryopsis* sp., *Dudresnaya* sp., and *Dictyosphaeria versluysii* were seen in the photoquadrats. During the random swim, *Cheilosporum* sp., *Chlorodesmis* sp., *Neomeris* sp., *Boergesenia* sp., *Titanophora* sp., and *Martensia* sp. were collected.

TUT 7 2/25/04 Poloa
This site was on the west side of Tutuila off from the village of Poloa. This site had high surge. The area surveyed had depths between 53 and 57 feet and was characterized by coral mounds separated by channels filled with turf-covered coral rubble. With the high surge, *Trichogloea* sp. and *Acrosymphyton* sp. were evident throughout the water column

like tumbleweeds. In addition to turf algae, *Acrosymphyton* sp., *Boergesenia* sp., *Trichogloea* sp., and *Liagora* sp. were seen in the photoquadrats. *Dictyosphaeria versluysii* and *Gelidiopsis* sp. were collected during the random swim.

TUT 8 2/25/04
This site was on the northwest side of Tutuila in a small bay that has a few old fales that appear to have been abandoned. The visibility at this site was less than 15 feet which may make pictures difficult to analyze. The site was characterized by large coral heads i.e., Porites separated by sand channels. Turf algae, *Acrosymphyton* sp., *Neomeris* sp., *Trichleocarpa* sp., *Peyssonnelia* sp., *Halimeda* sp., crustose coralline algae, and *Gelidiopsis* sp. were seen in the photoquadrats. *Amphiroa* sp., *Chlorodesmis* sp., *Haloplegma* sp., and *Cheilosporum* sp. were collected during the random swim.

Table 2: Average occurrence and rank of species at sites visited on Tutuila

	Percent occurrence in photoquadrats *Standard Deviation*	**AVERAGE RANK** *Standard Deviation*	
Green Algae			
Boergesenia	**0.38** *1.78*	**3.00**	
Boodlea			*
Bryopsis	**1.14** *2.93*	**3.33** *1.53*	
Caulerpa	**0.76** *3.55*	**4.50**	
Chlorodesmis	**1.52** *3.29*	**3.50** *1.29*	
Dictyosphaeria	**5.30** *11.66*	**3.64** *0.76*	
Halimeda	**29.55** *30.51*	**3.31** *0.89*	
Neomeris	**3.03** *8.35*	**3.25** *0.75*	
Tydemania	**0.38** *1.78*	**5.00**	
Valonia			*
Ventricaria	**1.52** *7.11*	**6.25**	
Red Algae			
Actinotrichia	**4.17** *9.88*	**4.90** *0.74*	
Acrosymphyton	**9.47** *17.87*	**3.17** *1.32*	
Amphiroa	**28.03** *35.22*	**3.61** *0.54*	

	Percent occurrence in photoquadrats *Standard Deviation*	**AVERAGE RANK** *Standard Deviation*	
Callophycus			*
Cheilosporum	**13.64** *22.65*	**3.23** *0.58*	
Chrysymenia			*
Corynocystis	**1.14** *5.33*	**4.00**	
Dudresnaya	**3.03** *9.81*	**4.13** *0.88*	
Galaxaura	**4.17** *11.14*	**4.80** *1.89*	
gelid	**0.76** *2.45*	**5.00** *0.00*	
Gelidiopsis	**1.14** *2.93*	**4.33** *0.58*	
Gibsmithia			*
Haloplegma	**0.76** *2.45*	**3.50** *0.71*	
Halymenia			*
Jania	**0.38** *1.78*	**5.00**	
Laurencia/Chondrophycus			*
Liagora	**1.52** *4.18*	**2.83** *0.76*	
Martensia			*
Peyssonnelia	**45.83** *31.99*	**3.15** *0.72*	
Portieria	**0.38** *1.78*	**6.00**	
Predaea	**0.38** *1.78*	**4.00**	
Titanophora	**0.76** *2.45*	**4.50** *0.71*	
Trichogloea	**1.14** *5.33*	**2.67**	
Tricleocarpa	**2.65** *7.45*	**3.81** *0.90*	
branched upright coralline	**1.52** *4.18*	**3.17** *1.04*	
crustose coralline	**76.14** *33.56*	**1.80** *0.47*	

	Percent occurrence in photoquadrats *Standard Deviation*	**AVERAGE RANK** *Standard Deviation*	
Brown Algae			
Dictyota	**3.79** *8.02*	**4.88** *1.45*	
Lobophora	**10.23** *23.28*	**3.07** *0.68*	
Cyanophytes	**24.24** *22.70*	**3.62** *0.68*	
Turf	**93.94** *13.16*	**1.85** *0.93*	

Appendix D: **Macroinvertebrates Rapid Ecological Assessment (REA) Team Activity Report** (*Scott Godwin*)

Manua Islands and Rose Atoll

Introduction

The purpose of the activities for OES-04-02 was to select sites surveyed during previous rapid ecological assessments for long-term monitoring and expand the baseline for survey sites. Selection of sites was based on their year-round accessibility and their representation of the habitats present at each site. Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey. This benthic survey was conducted collaboratively with fish surveys. This report will cover the non-coral invertebrates encountered and from this point forward any mention of marine invertebrates will mean this particular group.

Methods

Quantitative counts for specific target marine invertebrates were done along two separate 2- by 25-meter belt transects. This was followed by two 10- by 25-meter quadrat surveys accomplished by swimming a zigzag search pattern. A quadrat survey was conducted in conjunction with both 2 by 25 transects, which were used as the reference line for the long axis. The counts from these two 10 by 25 quadrats were combined into a single 10- by 50-meter area.

Based on data from previous rapid ecological assessments, a group of target species was chosen for quantitative counts. The species in this list were chosen because they have been shown to be common components of the reef habitats of the central and southern Pacific, and they are species that are generally visible (i.e., non-cryptic) and easily enumerated during the course of a single 50-60-minute SCUBA survey.

These target species were:

CNIDARIA

Zoanthids – rubber corals

Actiniaria – Anemones

Hydrocorals – Lace corals

ECHINODERMS

Echinoids – sea urchins

Holothuroids – sea cucumbers

Ophiuroids – brittle stars (generally cryptic but are visible in some cases)

Crinoids – feather stars

MOLLUSCA

Bivalves – ark shells, spondylid oysters, pearl oysters, tridacnid clams

Nudibranchs – sea slugs

Gastropods – snails

Cephalopods - octopus

CRUSTACEA

hermit crabs, lobsters, large crabs, and shrimp

Collections of species that cannot be identified in the field, and samples of coral rubble were brought back to the laboratory on the research vessel. The cryptic organisms found in the rubble are picked out and preserved, and the sand samples are dried and bagged so they can be examined for micro-mollusks at a later date.

The marine invertebrate species recorded and identified during the course of the field operations for OES-04-02 represent the non-cryptic fauna of the reef habitat and **should not** be considered the only species present at each site. There is an abundance of other organisms, both cryptic and non-cryptic, that dwell in these habitats that are not included in the rapid assessment scheme, which will be included in a final species inventory at a later date.

Sample Sites
Manua Islands
Ofu, Olosega, and Tau
Total Sites Surveyed: 18

SITE ID	LOCAL DA TE	LATITUDE	LONGITUDE	NOTES
OLO-01	2004-02-06	14' 10.142	168' 36.496	E side Olosega
OLO-04	2004-02-06	14' 10.878	169' 37.611	Off Olosega village
OLO-05	2004-02-07	14' 09.817	169' 37.464	N side, off Sili village
OFU-06	2004-02-07	14' 10.401	169' 40.883	W side Ofu, off Ofu village
OFU-03	2004-02-07	14' 11.820	169' 39.677	Off E end of runway (Ofu), fish and coral only
OFU-07	2004-02-07	14' 10.476	169' 38.855	Backreef, algae and invert only
OLO-06	2004-02-13	14' 11.228	169' 36.500	SE side Olosega
OFU-02	2004-02-13	14' 11.076	169' 40.561	W side Ofu, off W end of runway
OFU-08	2004-02-13	14' 10.271	169' 41.134	W side Ofu, off Ofu village, near Nuutele island
TAU-07	2004-02-04	14' 13.644	169' 25.104	N end of E side
TAU-02	2004-02-04	14' 15.060	169' 26.816	S side at Laufuti Stream
TAU-08	2004-02-04	14' 15.737	169' 28.485	SW side, Papautam Pt.
TAU-04	2004-02-05	14' 12.744	169' 26.442	W of airport on N. side
TAU-05	2004-02-05	14' 12.877	169' 29.404	N. side near Loto Pt.
TAU-09	2004-02-05	14' 14.734	169' 30.387	W side S of Tau Village
TAU-10	2004-02-12	14' 12.876	169' 28.084	Central N shore
TAU-11	2004-02-12	14' 13.026	169' 30.748	Faleasau Village
TAU-12	2004-02-12	14' 15.476	169' 30.026	A. Greene site

The sites surveyed at Ofu and Olosega represented a variety of forereef and backreef habitats. With the exception of the site OFU-06 the condition of all sites appeared to be good. The OFU-06 site was in very poor condition because of damage from a freshwater storm runoff from a past storm event. This site has experienced a complete phase shift away from a coral dominated community to an algae dominated community. All other sites surveyed had a typical balanced compliment of species. Tridacnid clam densities were variable and gastropods and sponges were the most common species at all sites.

Rose Atoll

Total Sites Surveyed: 13

SITEID	LOCAL DATE	LATITUDE	LONGITUDE	NOTES
ROS-01	**2004-02-08**	**14' 32.370**	**168' 08.742**	**E side**
ROS-02	**2004-02-08**	**14' 33.088**	**168' 08.379**	**S. side**
ROS-03	**2004-02-08**	**14' 33.316**	168' 08.898	**S. side**
ROS-21	**2004-02-09**	**14' 33.485**	**168' 09.194**	**SW side, A. Green SE1 site**
ROS-04	**2004-02-09**	**14' 33.565**	**168' 09.628**	**West side**
ROS-22	**2004-02-09**	**14' 32.766**	**168' 10.274**	**A. Green NW1 site**
ROS-23	**2004-02-10**	**14' 32.533**	**168' 10.361**	**A. Green SE3 site**
ROS-7P	**2004-02-10**	**14' 32.969**	**168' 10.095**	**W. side, east of wreck site**
ROS-05	**2004-02-10**	**14' 33.249**	**168' 09.880**	**W. side, west of wreck site**
ROS-06	**2004-02-11**	**14' 32.187**	**168' 09.989**	**N. side**
ROS-08	**2004-02-11**	**14' 32.267**	**168' 09.218**	**Patch reef immediately inside channel**
ROS-24	**2004-02-11**	**14' 32.256**	**168' 09.397**	**Back reef W. of channel**
ROS-9P	**2004-02-11**	**14' 33.072**	**168' 09.619**	**CREWS buoy site**

The majority of sites surveyed at Rose Atoll were on the forereef. The east side reef environments were dominated by crustose coralline algae, the green algae Microdictyon, and coral. Most of the west reef sites were dominated by Pocilloporid corals, and Microdictyon was not apparent. The sites ROS-07P and ROS-05 were in the vicinity of a recent wreck site. Site ROS-07P has been extremely affected by the remainder of the iron wreckage, with the site being overtaken by cyanobacteria and turf algae. The ROS-05 site, on the other hand appears to be quite healthy and had the greatest diversity of invertebrate species of any site. Overall, the macroinvertebrate communities on the forereef were composed of very cryptic species associated with living and dead Pocilloporid coral heads and rubble. Tridacnid clams were rare on the outer reef and the most dominant organisms were hermit crabs, sponges, and gastropods. The patch reefs in the lagoon had low diversity but high abundance of species. The patch reef at site ROS-08 had high abundance of all organisms except tridacnid clams. This site was rumored to be a site where clam poaching has taken place. By comparison, another patch reef on the

far west side of the lagoon (ROS-09P) had an extremely abundant population of giant clams and other species. The single backreef site surveyed was dominated by gastropods, and tridacnid clams were extremely rare.

Swains Island

Introduction

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Sample Sites
Total Survey Sites: 9

SITE ID	LATITUDE	LONGITUDE	NOTES
SWA-08	11' 02.748	171' 04.587	NW side
SWA-06	11' 02.860	171' 05.206	NW side
SWA-07	11' 03.086	171' 03.937	NE side
SWA-10P	11' 03.793	171' 04.238	S. side
SWA-14	11' 04.036	171' 04.581	S. side
SWA-01	11' 04.094	171' 04.878	W. side
SWA-03	11' 03.457	171' 05.480	W. side, S. of channel
SWA-5P	11' 03.331	171' 05.511	W. side, directly in front of village
SWA-15	11' 03.301	171' 05.408	Back reef in front of village

Site Narratives

SWA-08, 06, 07, 10P, 14, 01
Reef slope dominated by Pocillopora and Montipora corals. Non-cryptic macroinvertebrates were rare and the species recorded were a hydroid from the genus *Gymangium*, the hermit crabs *Calcinus minutus*, *Calcinus gaimardii* and *Dardanus lagopodes*, the caridea shrimp *Saron*, the gastropod *Astralium rhodostoma* and an unknown drupe shell. There was a conspicuous low abundance of trapezid crabs, which

are commensal with Pocilloporid corals. Pocilloporids are extremely common at this site and the low numbers of these crabs is unusual. A yellow sponge species from the genus Aplysina was common at the site. There is clear storm damage from a recent hurricane, with the Montipora plate coral species receiving the largest share of the damage.

SWA-03
A site that has experienced a large amount of storm disturbance. There was much in the way of damage to the coral community. This site had a different habitat, which was composed of spurs with shallow grooves. The species makeup was the same as previous sites surveyed, except that there was a rare occurrence of *Tridacna squamosa*. The shrimp *Saron* was very abundant and there was a common occurrence of the gastropod *Astralium rhodostoma*. A single *Acanthaster planci* was recorded at the site.

SWA-5P
A disturbed habitat that had the highest recorded non-coral invertebrate diversity of any sites surveyed at Swains Island. Two species of holothuroid and a single species of echinoid were present. The holothuroids were *Bohadschia argus* and *Thelonota ananas* and the echinoid was *Echinostrephus aciculatus*. The habitat was markedly different than any of the other sites surveyed. There was not a predominance of Pocilloporid corals, and a more diverse habitat with sand channels existed. This is the only site at Swains Island within the 35-50-feet depth range that had echinoderms present.

SWA-15
A back reef habitat dominated by gastropods. This habitat is a scoured carbonate substrate with pits and sand patches and receives strong wave action at high tide and total desiccation at low tide. The gastropods present were: *Drupa ricina*, *Drupa morum*, *Drupa rubusidaea*, *Thais aculeate*, *Conus ebraeus*, and *Conus chaldaeus*. The hermit crabs *Calcinus elegans*, *Calcinus minutus*, and *Calcinus gaimardii* were also present in patchy distributions concentrated in the sand patches and pits.

General Impressions

The majority of the habitat at Swains Island is steeply sloping and composed mainly of three genera of corals (Pocillopora, Porites and Montipora). The invertebrate fauna was mostly cryptic and not very abundant of diverse. Within the survey range of 35-50 feet typical species associated with this habitat, such as echinoderms, were absent. The exception to this was the west side of the island near the boat passage. The sites SWA-5P and SWA-03 would be described as disturbed habitats from the standpoint of corals but the non-coral invertebrate diversity of non-cryptic organisms was quite high. This could be attributed to the greater variety of habitats available at these sites opposed to other sites surveyed. All other sites but these are in a pioneer species stage and the non-coral invertebrate community is mostly represented by those species that associate themselves with pioneering coral species such as Pocillopora. Crown-of-Thorns starfish were concentrated at deep sites on the south side of the island and only a few individuals were recorded in the 35-50-feet depth zone at all sites. Tridacnid clams were only recorded from the SWA-5P and SWA-03 sites and were represented by both *Tridacna maxima* and *Tridacna squamosa*.

Tutuila

Introduction

The purpose of the activities for OES-04-02 was to select sites surveyed during previous rapid ecological assessments for long-term monitoring and expand the baseline for survey sites. Selection of sites was based on their year-round accessibility and their representation of the habitats present at each site. Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey. This benthic survey was conducted collaboratively with fish surveys. This report will cover the non-coral invertebrates encountered and from this point forward any mention of marine invertebrates will mean this particular group.

Methods

Quantitative counts for specific target marine invertebrates were done along two separate 2- by 25-meter belt transects. This was followed by two 10- by 25-meter quadrat surveys accomplished by swimming a zigzag search pattern. A quadrat survey was conducted in conjunction with both 2 by 25 transects, which were used as the reference line for the long axis. The counts from these two 10 by 25 quadrats were combined into a single 10- by 50-meter area.

Based on data from previous rapid ecological assessments, a group of target species was chosen for quantitative counts. The species in this list were chosen because they have been shown to be common components of the reef habitats of the central and southern Pacific, and they are species that are generally visible (i.e., non-cryptic) and easily enumerated during the course of a single 50-60-minute SCUBA survey.

These target species were:

CNIDARIA

Zoanthids – rubber corals

Actiniaria – Anemones

Hydrocorals – Lace corals

ECHINODERMS

Echinoids – sea urchins

Holothuroids – sea cucumbers

Ophiuroids – brittle stars (generally cryptic but are visible in some cases)

Crinoids – feather stars

MOLLUSCA

Bivalves – ark shells, spondylid oysters, pearl oysters, tridacnid clams

Nudibranchs – sea slugs

Gastropods – snails

Cephalopods - octopus

CRUSTACEA

hermit crabs, lobsters, large crabs and shrimp

Collections of species that cannot be identified in the field, and samples of coral rubble were brought back to the laboratory on the research vessel. The cryptic organisms found in the rubble are picked out and preserved and the sand samples are dried and bagged so they can be examined for micro-mollusks at a later date.

The marine invertebrate species recorded and identified during the course of the field operations for OES-04-02 represent the non-cryptic fauna of the reef habitat and **should not** be considered the only species present at each site. There is an abundance of other organisms, both cryptic and non-cryptic, that dwells in these habitats that are not included in the rapid assessment scheme, which will be included in a final species inventory at a later date.

Site Surveys

Total survey sites: 22

SITE ID	LOCAL DATE	LATITUDE	LONGITUDE	NOTES
TUT-15	2004-02-18	S14' 18.924	W170' 39.388	Taiema Bank
TUT-16	2004-02-19	S14' 17.130	W170' 33.844	Anuu Island
TUT-17	2004-02-19	S14' 14.765	W170' 34.309	NE, near NOAA solar rad. Station
TUT-04	2004-02-19	S14' 15.377	W170' 36.367	Masausi village
TUT-05	2004-02-20	S14' 15.110	W170' 37.413	Masafau Bay
TUT-14	2004-02-20	S14' 15.223	W170' 39.155	Afono Bay
TUT-18	2004-02-20	S14' 15.114	W170' 41.349	Tafau Bay
TUT-13	2004-02-21	S14' 15.636	W170' 42.720	Muliulu Point
TUT-19	2004-02-21	S14' 16.994	W170' 43.680	Fagasa Village
TUT-12	2004-02-21	S14' 17.393	W170' 45.568	Massacre Bay
TUT-02	2004-02-22	S14' 16.667	W170' 36.430	Fagaitua Bay
TUT-01	2004-02-22	S14' 17.066	W170' 38.275	Alega, Tisa's Bar
TUT-20	2004-02-22	S14' 16.705	W170' 40.163	Aua, Pago Pago Harbor
TUT-10	2004-02-23	S14' 18.683	W170' 41.588	Nuuuli Road Construction Site
TUT-09	2004-02-23	S14' 20.157	W170' 42.271	Airport
TUT-21	2004-02-23	S14' 21.069	W170' 43.718	Turtle and Shark legend site
TUT-11	2004-02-24	S14' 21.621	W170' 45.037	Larsen Bay
TUT-22	2004-02-24	S14' 21.957	W170' 45.801	Fagatele Bay
TUT-23	2004-02-24	S14' 20.579	W170' 47.333	Leone
TUT-06	2004-02-25	S14' 19.684	W170' 49.932	Amanave Village
TUT-07	2004-02-25	S14' 18.960	W170' 50.241	Poloa Village
TUT-08	2004-02-25	S14' 17.495	W170' 46.830	Aoluau Bay

Site Narratives

TUT-15
Taiema Bank off southern Tutuila. Survey conducted at the top of the bank. The habitat was made up of carbonate pavement with pits and boulders. The boring urchin *Echinostrephus* and an unknown sponge were the dominant visible macroinvertebrates. The majority of the fauna were sessile organisms underneath the boulders. This fauna was composed of tunicates, sponges, bryozoans, and ophiuroids.

TUT-16
The site was located off the west coast of Aunuu Island. A great diversity of corals existed, as well as many other types of macroinvertebrates. The majority of species were sponges and soft corals but crustaceans and echinoderms were also common. The majority of crustaceans were trapezid crabs and the hermit crabs *Calcinus minutus*, *Calcinus gaimardii*, and *Dardanus lagopodes*. The echinoderms were ophiuroids and crinoids, the latter being quite abundant. Sea fans likely from the genus Melithaea were noted at a depth of around 80 feet on the reef slope. *Tridacna maxima* was present but rare.

TUT-17
Located on the northeast side of Tutuila near the NOAA solar radiation lab. This site was dominated by crustose coralline algae with very little coral cover. This site appears to be recovering from some sort of disturbance, likely a storm event. The reef slope was closely associated with a broad sand expanse with boulders and coral rubble. The reef was populated by a variety of gastropods, hermit crabs, and an orange axinellid sponge. The most common gastropod was *Astralium rhodostoma*, and the tridacnid clam *Tridacna maxima* was rare.

TUT-04
An embayment in front of Masausi village. The habitat was a sandy bottom with boulders and reef buttresses and large Porites coral heads. The soft corals *Cladiella*, *Lobophyton*, and *Rumphella* were present as was an unidentified *Heteractis carpet* anemone. The gastropods *Turbo petholatus*, *Conus striatus*, *Conus generalis*, *Conus rattus*, *Conus pulicarius,* and *Conus marmoreus* were seen.

TUT-05
The site was located at Masafau Bay and was made up of a reef slope with Montipora and Acropora and abundant algae. The organisms recorded as most abundant were tunicates and gastropods. The tunicates were a variety of didemnid species and the gastropods were mostly coralliophilids. Echinoderms were present but not very abundant. The echinoderms present were crinoids, Echinometra urchins, and a single Crown-of-Thorns starfish. Tridacnid clams were rare at the site.

TUT-14
Reef community composed of buttresses and a broad sand expanse. An abundance of sponges and mollusks were present. There were three common sponges: a Leucetta

species, and orange “Stylotella” type, a black “Hyrtios” type and a gray species resembling *Hippospongia*. The mollusks were coralliophilid snails and *Spondylus* bivalves. The soft corals *Sarcophyton* and *Lobophyton* were also common. Tridacnid clams were common on the crest of the slope at 20-25 feet deep.

TUT-18
A site located within Tafou Cove. This was a complex habitat composed of steeply sloping buttresses and boulders. There were abundant sand channels, pits, and caves with overhangs. The corallimorpharian *Rhodactis howseii* was extremely abundant and a variety of sponges existed. The sponges were an orange “Stylotella” type, Leucetta, and unknown yellow species, an orange “Spheciospongia” species, and unknown light gray species.

TUT-13
In the vicinity of Muluilu Point. An open coast site with steep slope and a scoured bottom with basaltic pinnacles. Two sponge species were prominent at the site: one was a gray Dysidia species and the other an orange “Stylotella” species. The urchin *Echinostrephus* was very abundant and an unknown species of crinoid was common. Two species of strombid gastropods were present and both were from the genus Lambis. There was a rare occurrence of small *Tridacna maxima*.

TUT-19
Site located off Fagasa village. Steeply sloping reef on the western fringe of an embayment dominated by algae. A black “Hyrtios” species of sponge was common, as was an orange “Stylotella” species. The only abundant non-coral macroinvertebrate present was the didemnid tunicate *Atriolum robustum*. There was a rare occurrence of the hermit crab *Paguritta corallicola*, while another species, *Calcinus minutus* was common.

TUT-12
Site located at Massacre Bay. Due to poor visibility, the survey was incorrectly conducted at a site different from the established location. The previous site was dominated by large Porites coral bommies, while the new site was dominated by rocks and fleshy algae. There was little in the way of non–coral macroinvertebrate abundance or diversity.

TUT-02
Site located on the eastern side of Fagaitua Bay. The site was a steep slope that was partially dominated by coral rubble and algae. An orange “Stylotella” sponge was very abundant, a red/orange Clathria was common, while a black “Hyrtios” species was rare. Gastropods were numerous at the site but there were none that were dominant.

TUT-01
Located at the cove where Tisa’s is located. The algae Halimeda was dominant in the depth zone from 25 to 45 feet. Two sponge species: a gray Dysidia and an orange “Stylotella” were the dominant non-coral invertebrates. The gastropod *Trochus*

maculatus was present but rare. The soft coral Cladiella was very abundant, especially at the depth range of 15-25 feet.

TUT-20
Aua site located on the eastern side of Pago Pago Harbor. The reef was a steep wall dominated by crustose coralline algae. An orange "Stylotella" sponge species was very abundant, as was a yellow Leucetta species. The gorgonacea Acabaria was very abundant under ledges throughout the site. The hydroid *Pennaria disticha* was common, while the hydrozoa Stylaster was rare. A species of nephtheid coral was present but rare.

TUT-10
Nuuuli road construction site. Steep reef slope with abundant crustose coralline algae and dominated by Lobophyllia coral. The soft coral *Cladiella* was abundant and the next most abundant macroinvertebrate was an unknown yellow didemnid tunicate. There were two carpet anemone species recorded at the site: *Entacmea quadricolor* and *Heteractis* sp. Giant clams were rare at the site.

TUT-09
Airport runway site. Broad expanse of carbonate pavement with a gentle slope. Coral diversity was high and all species were low growing. There were a large number of gastropods and a variety of sponge species. No tridacnid clams were recorded at the site.

TUT-21
Complex habitat located off the golf course near Leone. This site had an extremely abundant gastropod fauna, with the species *Conus miles* being the most prominent. Giant clams were common throughout the site. Two sponge species were common at the site, *Stylotella* and *Dysidia*.

TUT-11
Site located in Larsen's Bay. Complex reef habitat with sand channels and rubble. The most numerous macroinvertebrate was the soft coral *Cladiella*. There were rare occurrences of the anemone *Heteractis malu* and the molluscs *Octopus cyanea* and *Tridacna maxima*.

TUT-22
Site located at Fagatele Bay. Gradual reef slope with average coral cover and little in the way of abundance or diversity of macroinvertebrates. Both the giant clams *Tridacna maxima* and *Tridacna squamosa* were present but rare.

TUT-23
Site located off the village of Leone. Complex reef habitat that appears to have experienced disturbance from either freshwater runoff or storm damage. The structure was very complex but the diversity and abundance of coral were sparse, and crustose coralline algae dominated the reef. The same was true for macroinvertebrates. The gastropods *Coralliophila violacea* and *Astralium* were common, while *Lambis scorpio* and *Cypraea argus* were rare.

TUT-06
Site located off Amanave village. This site has been drastically affected by storm events since it was surveyed by CRED in 2002. A combination of freshwater runoff and sedimentation has served to decrease coral cover. Montipora corals have fared the best at this site and their associated coralliophilid snails were the most numerous mollusk, while tridacnid clams were rare. Sessile invertebrate species that are known to be tolerant of sedimentation, such as acanthellid sponges and zoanthid cnidarians were the most abundant at the site.

TUT-07
Located off Poloa village. Isolated reef habitat dominated by Montipora and Pocillopora corals associated with a field of sand and small boulders. The coral area was dominated by two sponge species, “Stylotella” and Dysidea, while the sand and boulders field had numerous gastropods. This site appears to receive considerable wave energy, and the species present appear adapted to that situation through low profile growth forms and cryptic behavior.

TUT-08
Aoluau Bay on the northwest shore. Complex reef structures with broad sand channels and pits. There was an abundance of sponges and didemnid tunicates. There was very little in the way of mobile species but the visibility on the day of the dive was less than 10 feet in some cases, and this affected the recording of species. Tridacnid clams were rare at the site.

General Impressions

There appears to have been a considerable effect from past storm events on many reef areas around Tutuila. A storm event reported from a year ago was said to have inundated areas with freshwater and this appears to be the case on certain reefs, which show marked differences from the previous CRED surveys of 2002. This storm event combined with a recent tropical storm have served to cause species of coral and other invertebrates to die off and cause physical damage to reefs. Not all reefs surveyed seem to be effected though. Particular sites that show obvious effects were at TUT-06 off Amanave, TUT-23 off Leone, and TUT-17. The reef sites on the north shore of Tutuila do not show any signs of change since the CRED 2002 surveys, and a new site surveyed at Aunuu Island was the most impressive of all sites surveyed around Tutuila. This site at Aunuu Island is quite exposed but does not appear to have been negatively affected by past storm events.

The presence of other natural stressors such as Crown-of-Thorns appear to be at an equilibrium level and not poised for an outbreak. There was little evidence of predation by this sea star on any reefs areas surveyed around Tutuila. Giant clams exist at the same level as was observed in 2002. Even in stressed areas the tridacnid clams are maintaining a stable population. This is not to say these highly prized species are abundant though. The population level is quite depressed as a result of harvesting but the populations do not appear to be declining. The distribution of this species can be extremely patchy and is composed almost exclusively of *Tridacna maxima*, with less than one percent being the species *Tridacna squamosa*.

Another observation from the CRED 2002 effort was the conspicuously low abundance of echinoderms on the sub-tidal reef slopes. This was also true for the 2004 survey effort, with the only echinoderm class present in most cases being crinoids. Holothuroids, echinoids, and asteroids were only recorded in more sheltered embayment habitats. The majority of echinoderm fauna in the reef habitats around Tutuila are present in shallow intertidal and subtidal habitats, which differs from reef habitats in areas such as Hawaii. The overall species list for species recorded quantitatively reveals sponges to be the most commonly seen invertebrates throughout all sites. In sites that were disturbed, sponges and zoathnids were the most commonly seen species. The species representing these groups are ones that tend to be more tolerant of salinity, temperature, and sedimentation effects.

Appendix E: **Towed Diver Team Activity Report** (*Rusty Brainard, Molly Timmers, Joe Laughlin, Jeremey Jones, and Stephani Holzwarth*)

Shallow water habitats were surveyed using pairs of towed divers on towboards equipped with a downward-looking high resolution digital still camera with dual strobes (benthic towboard) and forward-looking digital video camera (fish towboard) to quantify habitat composition and complexity and abundance and distribution of ecologically and economically important fish and macroinvertebrate taxa. The downward-looking camera was maintained ~1 m of the bottom and was programmed to photograph benthic substrate every 15 seconds. The benthic towboard was also equipped with paired red lasers to project a 20-cm scale onto the digital imagery. The diver-observer on the benthic towboard observed and recorded habitat composition and characteristics (substrate percentages) over 5-minute ensembles and tallied conspicuous macroinvertebrates (crown-of-thorns seastars, boring and free urchins, sea cucumbers, giant clams, octopus, lobster), and marine debris. The diver-observer on the fish towboard recorded fish greater than 50 cm total length along a 10-m swath for 4 minutes followed by a 1-minute all around search in the same 5-minute ensembles as the benthic observer. Both towboards were instrumented with precision temperature and depth recorders (Seabird SBE39). GPS positions, temperature, and depth were recorded every 5 s along each transect. The data were downloaded and presented in an ArcView GIS and overlaid on high resolution IKONOS imagery.

During the cruise (Feb. 3 – 26, 2004), a total of 115 towed-diver surveys covering ~231 km of habitat were conducted around the Manu'a Island group of Ta'u, Olesega, and Ofu Islands, Rose Atoll, Swains Island, Tutuila Island, and Aunu'u Island. Of these, 18 tows were conducted around Ta'u covering ~39 km of habitat (Fig. 1); 18 tows were conducted around Ofu and Olesega Islands covering ~40 km of habitat (Fig. 2); 22 tows were conducted around and within Rose Atoll covering ~45 km of habitat (Fig. 3); 14 tows were conducted around Swains Island covering ~26 km of habitat (Fig. 4); 39 tows were conducted around Tutuila Island covering ~74 km of habitat (Fig. 5); and 4 tows were conducted around Aunu'u Island covering ~7 km of habitat (Fig. 5). Of the 22 towed-diver surveys at Rose Atoll, 16 tows were conducted along the forereef, 4 along the backreef, and 2 within the central lagoon. In the forereef habitats, six tows were conducted along an ~15 m mid-depth isobath covering 11.57 km of habitat surveyed; six tows were conducted along an ~25 m deep isobath covering 9.27 km of habitat; and four tows were conducted along an ~5 m shallow isobath covering 10.08 km of habitat. The 14 tow surveys around Swains Island resulted in three circumnavigations at similar shallow, mid, and deep depths. Of the 39 Tutuila tow surveys, 2 were conducted over a 20-25-m bank off the northwest coast off Fagamalo and 1 was conducted over Taema Bank south of Pago Pago Harbor.

Fish Observations: (Joe Laughlin, Jeremey Jones, and Stephani Holzwarth)

Manu'a Islands and Rose Atoll

Parrotfishes were the most commonly observed fishes. They were over 50 cm total length (TL) with over 205 observations including 158 sightings of the pacific steep head parrotfish (*Chlorurus microrhinos*) and 45 observations of the redlip parrotfish (*Scarus rubroviolaceus*). Surgeonfishes were also commonly sighted with 146 observations primarily of the blacktongue unicornfish (*Naso hexacanthus*). The most commonly observed sharks for this survey period were the benthic feeding reef whitetip shark (*Triaenodon obesus*) with eight observations and the reef blacktip shark (*Carcharhinus melanopterus*) with seven observations. It was noted that the gray reef shark (*Carcharhinus amblyrhyncos*) was only sighted 4 times throughout this survey period (40 surveys covering 85 km of habitat). Other notable observations included 13 sightings of the Napoleon wrasse (*Cheilinus undulatus*), 3 sightings of the bumphead parrotfish (*Bolbometopon muricatum*), and a large aggregation of big eye jacks (*Caranx sexfasciatus*) with over 750 individuals just south of the pass into the lagoon at Rose Atoll.

Swains Island

Fish observations at Swains Island were greatly influenced by the presence of several large schools primarily on the island's north reef. These schools were encountered several times throughout the survey resulting in an artificially high total count for certain species. Rainbow runners (*Elagatis bipinnulata*) were the most commonly recorded fish over 50 cm total length (TL) with 532 observations including a single observation of over 400 fish. The second most commonly observed fish for this survey period was the blackfin barracuda (*Sphyraena qenei*) with 501 observations, stemming from multiple encounters with a school of approximately 80 individuals. Planktivores were also common, especially the blacktongue unicornfish (*Naso hexacanthus*) and snappers of the genus Macolor (*M. macularis* and *M. niger*). Other notable observations included 29 sightings of the Napoleon wrasse (*Cheilinus undulatus*), 23 sightings of the dogtooth tuna (*Gymnosarda unicolor*), and a large aggregation of bigeye jacks (*Caranx sexfasciatus*) with over 2000 individuals milling loosely on the north reef of the island.

Tutuila and Aunu'u Islands

Parrotfishes were the most commonly observed fishes. They were over 50 cm total length (TL) with 218 observations including 83 sightings of the pacific steep head parrotfish (*Chlorurus microrhinos*) and 84 observations of the redlip parrotfish (*Scarus rubroviolaceus*). Surgeonfishes were also commonly sighted with 78 observations primarily of the blacktongue unicornfish (*Naso hexacanthus*). The most commonly observed shark for this survey period was the benthic feeding reef whitetip shark (*Triaenodon obesus*) with nine observations. It was noted that the gray reef shark (*Carcharhinus amblyrhyncos*) was only sighted 3 times throughout this survey period. Other notable observations were 12 sightings of the Napoleon wrasse (*Cheilinus undulatus*) over 50 cm TL.

Benthic Observations: (Molly Timmers and Rusty Brainard)

Ta'u Island (Fig. 1)

The dominant habitat along the forereef slopes of the west and south shores of Ta'u was observed to be carbonate pavement. The forereef slopes along the north and east shores were dominated by both carbonate pavement and spur and groove habitats. For the 18 towed-diver habitat surveys, there was an average of 23.9% live coral cover with 4.67% appearing pale (or stressed), and 1.12% appearing white. A total of 0.31% appeared to have recently died. A total of ~593 giant clams (*Tridacna sp.*) were observed for an average of ~15.2 per linear kilometer of survey. No crown-of-thorns starfish (*Acanthaster sp*.) was observed. Very large (~10 m across) *Porites sp.* coral heads (bommies) were observed along portions of the east and west forereef slopes. A precipitous vertical wall was observed along much of the south shore. The tips of many of the branching corals (*Pocillopora sp*. and *Acropora sp*.) were observed to be broken, particularly on the shallow north and west forereefs.

Ofu and Olosega Islands (Fig. 2)

The dominant habitats observed along the forereef slopes of the south, west, and north shores of Ofu and Olesega Islands consist of carbonate pavement and spur and groove. The forereefs of the east shores were observed to be continuous reef and carbonate pavement. For the 18 towed-diver habitat surveys, there was an average of 15.5% live coral cover with 1.95% appearing pale, 0.7% appearing pale white, and 2.9% appearing recently dead. The highest incidents of recently dead coral habitat were located along the west and north reef slopes. A moderate amount of the shallow branching corals (*Pocillopora sp.* and *Acropora sp*.) were observed broken or leveled across their tops. Many of these broken corals appeared to have been subsequently invaded by turf algae, initially at the tips and moving along the stems. A few of these branching corals were nearly completely covered with turf algae, indicating likely mortality. This breakage is assumed to be in response to the passage of category 5 Hurricane Heta in early January 2004. A total of ~114 giant clams were observed for an average of ~2.9 per linear kilometer of survey. No crown-of-thorns seastars (*Acanthaster sp*.) were observed.

Rose Atoll (Fig. 3)

The dominant habitats observed along the forereef consisted of continuous reef and carbonate pavement. The dominant habitats along the backreef and lagoon environments were observed to be pinnacle patch reefs, rubble, and sand flats. Typical depths of lagoon interior are 20-25 m. The outer reef slopes are generally very steep, except for gently sloping terraces on the north end and on the northeast end of the diamond shaped atoll. Coral and algae cover are generally depth stratified on all of the reef slopes. Typically, live coral cover is low over the shallow forereefs (2-5 m) and moderately good (15-40%) over the intermediate depths (5-18 m). Overall, live coral cover for the forereef slopes was 25.3%. In these intermediate depths, members of the genus *Pocillopora* dominate the coral fauna, followed by faviids, *Porites*, *Montipora*, *Acropora*, and soft corals. Along some of the deeper (18-30 m) areas, such as the reef

slope on the southeast and northwest sides, live coral cover, including octocorals and the presence of massive colonies of *Porites*, was high (40-60%). The carbonate platform that forms the basis of the atoll is heavily encrusted with coralline algae and, to a substantially lesser extent, fleshy and turf algae. Assessments of 40–60 % cover by coralline algae are common throughout many of the surveys.

Out of the 22 towed-diver habitat surveys, 3.27% of the coral habitat appeared pale, 2.18% appeared white, and 0.4% appeared to have recently died. The coral habitat appearing white was primarily observed on *Pocillopora sp*. primarily along the shallow southwest forereef slope of the atoll. The pattern of white Pocilloporids suggested possible crown-of-thorns predation. Surprisingly, however, not a single crown-of-thorns seastar (*Acanthaster sp*.) was observed during 22 towed-diver surveys. With similar effort, the 2002 towed-diver surveys at Rose Atoll did not note a similar pattern of white Pocilloporids, but did note that no crown-of-thorns were observed. Between the 2002 and 2004 surveys, over ~99 km of habitats between depths of 3 m and 30 m were surveyed without a single observation of crown-of-thorns.

Towed-diver surveys at Rose Atoll revealed very few conspicuous macroinvertebrates, the exception being giant clams (*Tridacna sp*.) on the patch reefs in the lagoon. A total of ~1136 giant clams were observed with 94.8% recorded in the backreef and lagoon environments for an average of 76.5 per linear km of lagoon and backreef survey. Very few free urchins and no lobsters were observed at Rose Atoll. In some areas of the shallow reef slopes, boring urchins were observed in high abundance. A few sea cucumbers (*Holothuroidea*) were observed during the towed-diver surveys.

At each of the three depths surveyed along the southwest reef slope, large increases in cyanobacteria (blue-green algae) were observed as the surveys approached the site of the 1993 shipwreck of the longliner *Jin Shiang Fa*. The effects of the wreck can be clearly seen over a distance of about 1 km. The cyanobacteria is much more abundant to the northwest of the wreck site than to the southeast, suggesting a mean alongshore current to the northwest.

Swains Island (Fig. 4)

The dominant habitat of the reef slopes around most of the island was continuous reef, with the exception along the south shore where spur and groove were observed. Live coral cover was generally high (20-65%) at shallow, mid, and deep depths around most of the island. Overall, live coral cover averaged 32.2% over all depths. The dominant coral fauna along the 5-m isobath appeared to be *Pocillopora sp.* However, along the 15-m isobath there appeared to be *Montipora sp.*, and along the 25-m isobath, *Porites sp.* Along the east shore, the benthos was dominated by dense thick *Microdictyon sp*.algal cover. Within the shallows (0 - ~12 m) along the north and west forereefs, extensive coral fragmentation and debris of Pocilliporids and Montiporids were observed. In many of these shallow areas, the large majority of the branching corals appeared to have been leveled. While most of the remaining stems and many of the coral fragments remained alive, some shallow areas had evidence of high recent mortality (0 – 42.9%), as evidenced by turf algae invasion on white corals. Interestingly, many of the coral fragments were alive and appeared to have initiated the process of recolonization. The nature (widespread physical breakage and recent mortality) and distribution (shallow reefs on west and north sides) of the damage, strongly suggest that the damage was

caused by the passage of Hurricane Heta on January 4-5, 2004. This category 5 hurricane passed along the west side of Swains. For the 14 towed-diver habitat surveys, 2.92% of the coral habitat appeared pale, 2.71% appeared white, and 5.8% appeared to have recently died. Only one giant clam (*Tridacna sp.*) was observed. A total of 90 crown-of-thorns seastars (*Acanthaster sp.*) were observed, a significant and noteworthy difference from all other areas of American Samoa surveyed. While crown-of-thorns were observed scattered around the entire island, predominantly deeper than ~12 m, 46.6% were located along the south or southeast reef slope. This localized infestation of crown-of-thorns caused significant coral damage through predation of Montiporids (primarily) and Pocilloporids.

Overall, Swains Island provided an interesting natural laboratory to study the life, death, and regeneration of reef ecosystems. The coral cover and fish abundance were the highest observed in American Samoa, yet the west and northwest reef slopes were severely impacted by physical damage by a recent hurricane, and the southeast side had a small crown-of-thorns infestation.

Tutuila and Aunu'u Islands (Fig. 5)

The dominant habitats around the entire island, including Aunuu Island and Taema Bank, were continuous reef and carbonate pavement except along the west side where the dominant habitats were continuous reef and spur and groove. Out of the 39 towed-diver habitat surveys around Tutuila, there was 19.2% live coral cover with 2.76% appearing pale, 0.89% appearing white, and 2.3% appearing to have recently died. Around Aunuu Island, the average live coral cover was 27.4% on the leeward sides of the island and 7.3% on the more exposed and banklike windward and southern sides. An estimated 69.2% of the recently dead coral was observed along the north shore of Tutuila between Cape Matatula and Afono Bay and 10.6% was observed along the southwest shore between Leone and Amanave. Most of the recently dead coral is presumed to have been caused by the January 4-5, 2004 passage of Hurricane Heta to the west of Tutuila. The amount of damage appeared to depend on the amount of exposed coral to the north and west swells generated by the storm. Some of the protected bays (e.g., Masefau Bay) on the north side of Tutuila appeared to have suffered little direct physical damage from the storm. More exposed areas, including less protected bays, were observed to have increased storm damage, as evidenced by an abundance of recently overturned Acroporids. In many areas, an estimated 10% of the table corals were overturned. Aside from direct physical damage from the storm, a few of the protected bays on the north side of Tutuila appeared to have suffered from increased siltation, possibly in response to reported increases of runoff due to removal or damage of terrestrial vegetation of the surrounding watershed (Peter Craig, personal communication). Possible evidence of the vegetation damage was a moderate abundance of palm fronds and other tree damage found along the reef on all sides of Tutuila.

Only two crown-of-thorns seastars (*Acanthaster sp.*) were observed and both were located in Masefau Bay. A total of 126 giant clams (*Tridacna sp.*) were observed.

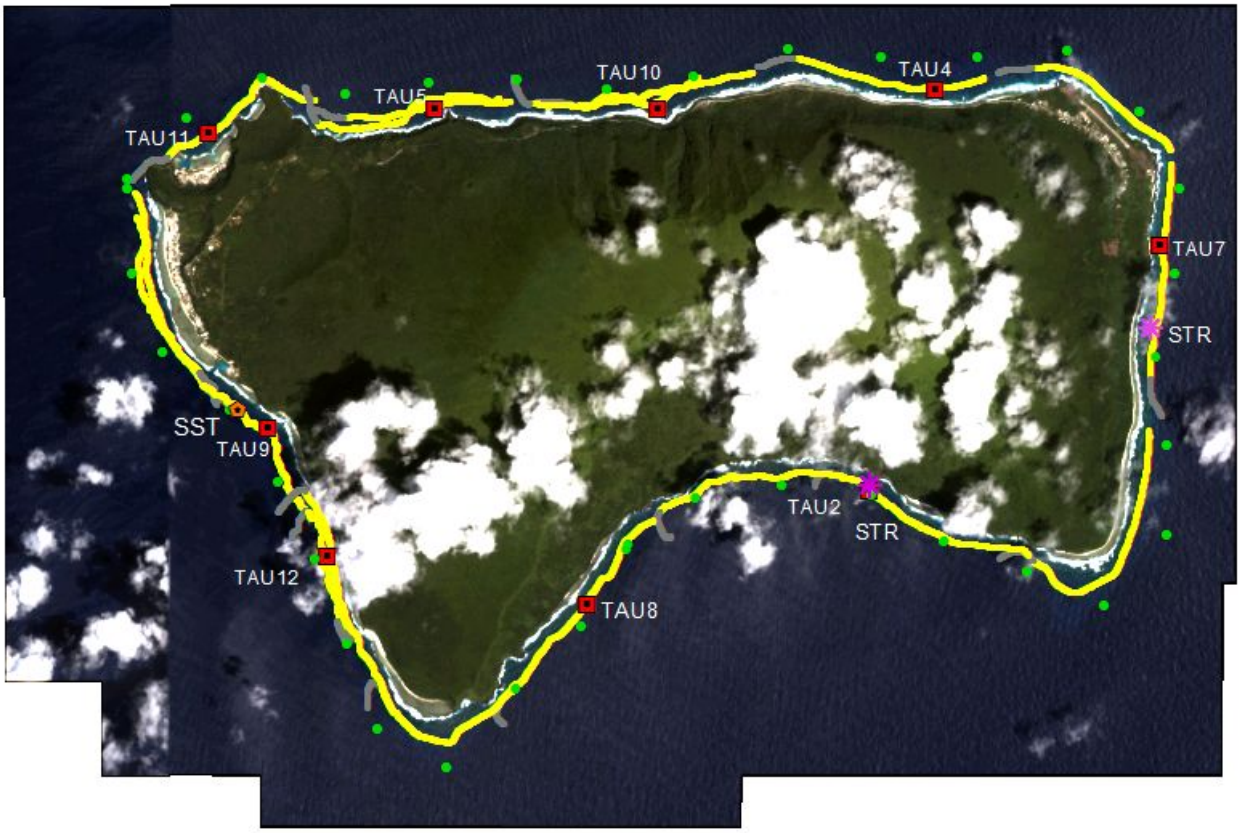

Figure 1. Field operations at Ta'u Island, American Samoa. Towed-diver habitat, fish and macroinvertebrate survey track are presented at yellow lines. Rapid Ecological Assessment survey sites are indicated as red squares (TAU1-12). Shallow water CTD and radiometer profiles are indicated by green and light blue circles, respectively. Subsurface temperature recorder (STR) deployment sites are indicated by purple asterisks. Sea surface temperature (SST) buoy deployment site is indicated by orange circle.

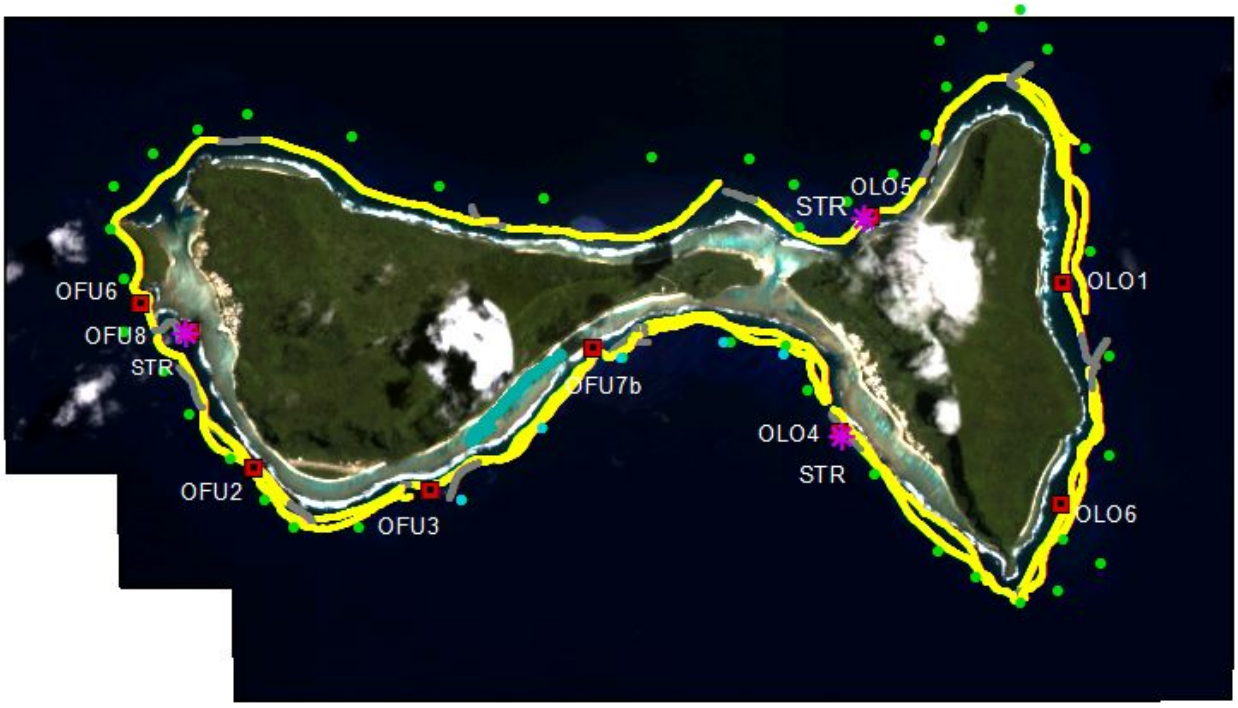

Figure 2. Field operations at Ofu and Olesega Islands, American Samoa. Towed-diver habitat, fish and macroinvertebrate survey track are presented at yellow lines. Rapid Ecological Assessment survey sites are indicated as red squares (OFU1-8 and OLO1-6). Shallow water CTD and radiometer profiles are indicated by green and light blue circles, respectively. Subsurface temperature recorder (STR) deployment sites are indicated by purple asterisks.

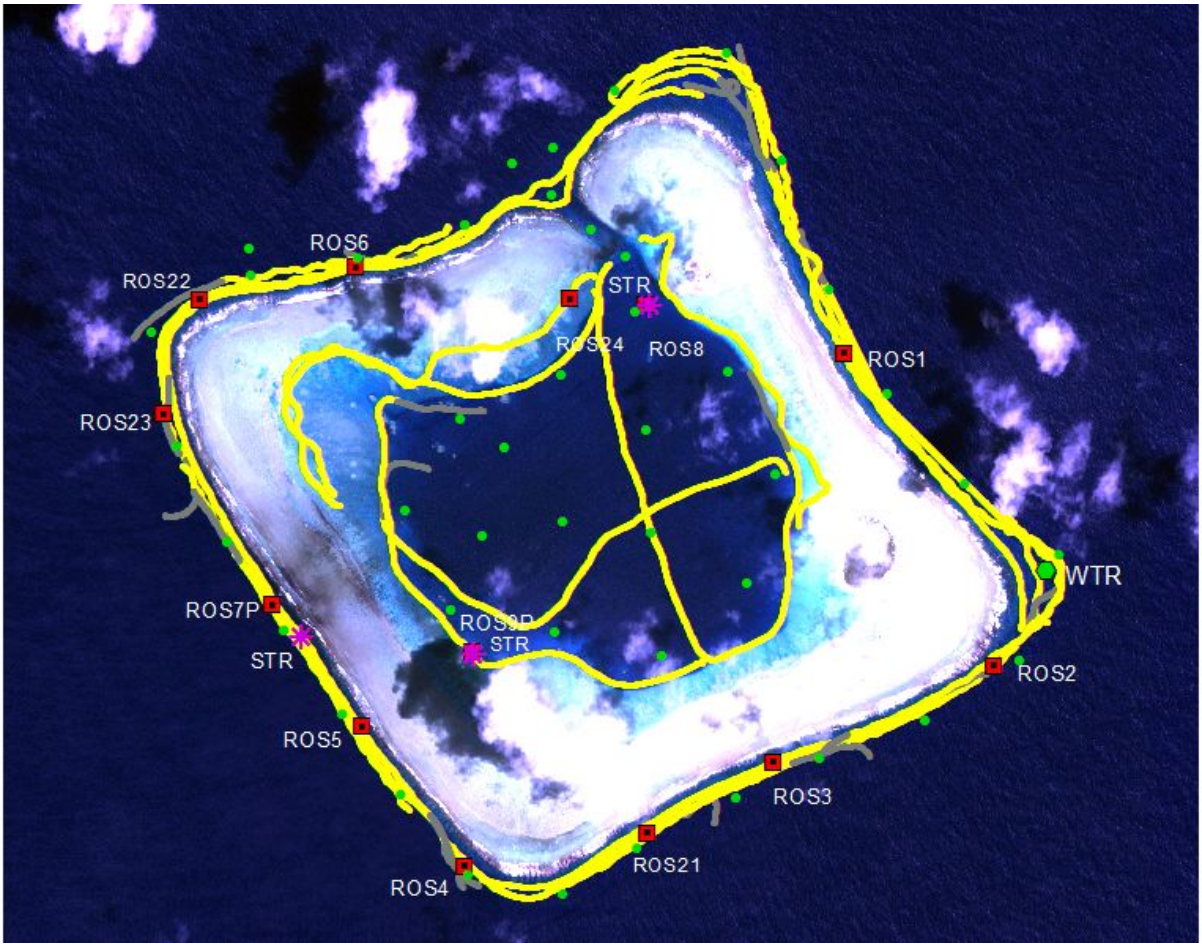

Figure 3. Field operations at Rose Atoll, American Samoa. Towed-diver habitat, fish and macroinvertebrate survey track are presented at yellow lines. Rapid Ecological Assessment survey sites are indicated as red squares (ROS1-22). Shallow water CTD and radiometer profiles are indicated by green and light blue circles, respectively. Subsurface temperature recorder deployment sites are indicated by purple asterisks. Coral Reef Early Warning System (CREWS) buoy site is at STR site near ROS9D REA site. Wave and tide recorder (WTR) deployment site is indicated by large green circle.

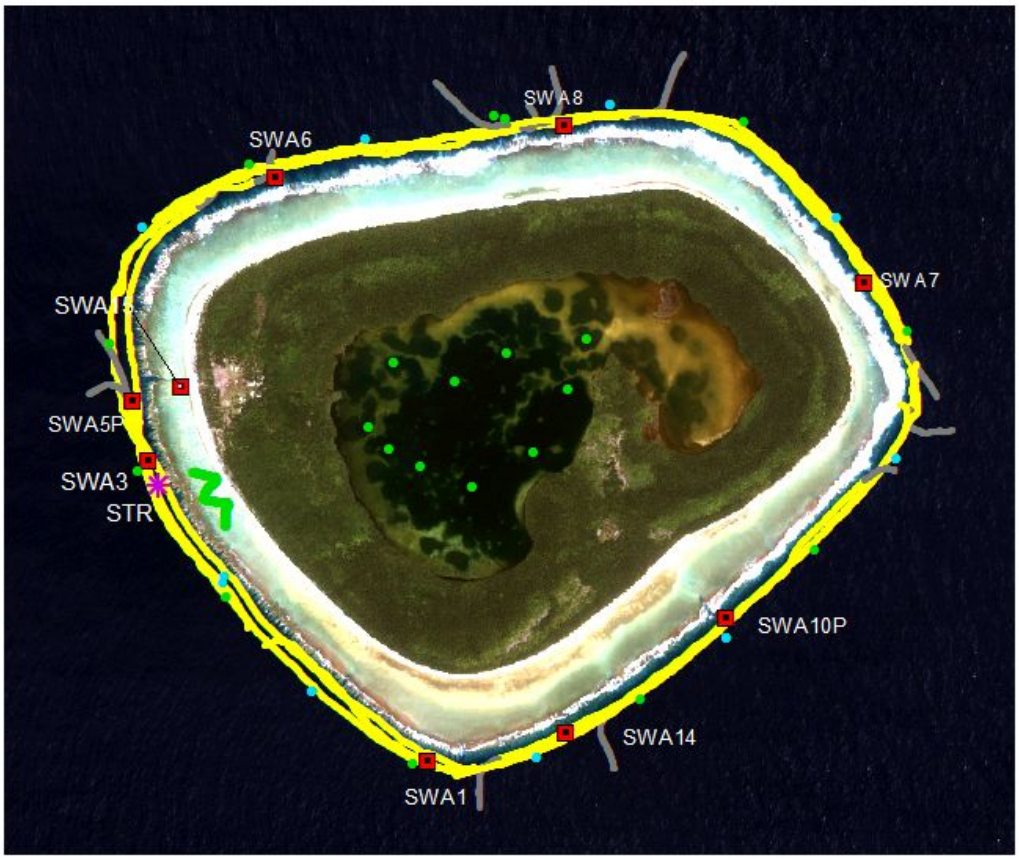

Figure 4. Field operations at Swains Islands, American Samoa. Towed-diver habitat, fish and macroinvertebrate survey track are presented at yellow lines. Rapid Ecological Assessment survey sites are indicated as red squares (SWA1-14). Shallow water CTD and radiometer profiles are indicated by green and light blue circles, respectively. Subsurface temperature recorder deployment sites are indicated by purple asterisks.

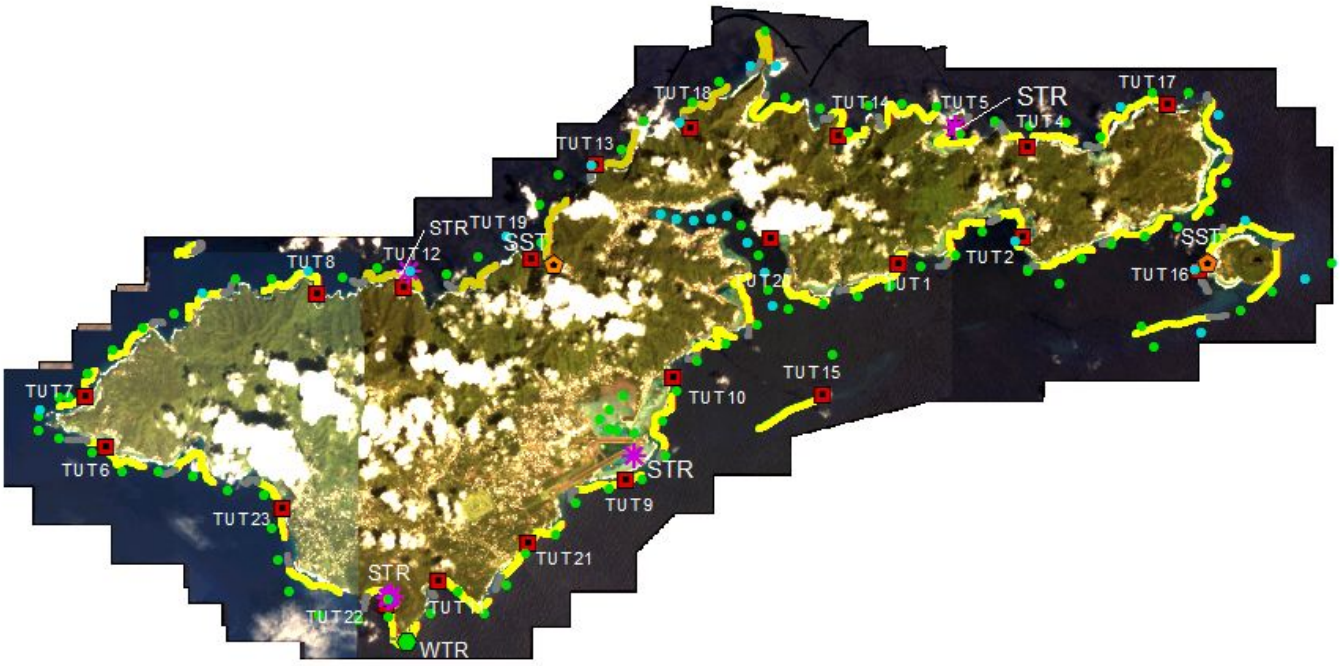

Figure 5. Field operations at Tutuila and Aunu'u Islands, American Samoa. Towed-diver habitat, fish and macroinvertebrate survey track are presented at yellow lines. Rapid Ecological Assessment survey sites are indicated as red squares (TUT1-23). Shallow water CTD and radiometer profiles are indicated by green and light blue circles, respectively. Subsurface temperature recorder deployment sites are indicated by purple asterisks. Wave and tide recorder (WTR) deployment site is indicated by large green circle.

Appendix F: **Oceanography Team Activity Report** (*Ron Hoeke, Kyle Hogrefe, Christy Kistner, Rusty Brainard, Megan Moews, John Rooney, and Phil White*)

The Samoan Archipelago, centered near 14º S latitude, is near the southern edge of the mean flow of the South Equatorial Current (SEC). SEC waters are characterized by warm (>26ºC), well-mixed, nutrient-depleted surface waters (Knauss, 1997). These conditions are modified by periodic tropical cyclones, occasional intrusions of cooler, subtropical waters from the south, and topographic and insular effects. Systematic assessment of oceanographic conditions during biological/ecological surveys, as well as long-term monitoring of oceanographic conditions and circulation, provide crucial links between physics and biology necessary to understand the coral reef ecosystem function.

Oceanographic assessments in American Samoa were accomplished by a combination of:

1. Continuous recording of surface and subsurface water temperatures as a function of depth during all towed-diver operations, providing a broad and diverse spatial temperature sampling method.
2. Shallow Water CTDs (max 35 m) at regularly spaced intervals around each island, sample vertical profiles of temperature, salinity, and turbidity providing indications for water masses and local sea water chemistry changes.
3. Profiling Radiometer casts (max 40 m), at select locations around each island, sample vertical profiles of discrete bands of visible light and natural florescence, both downwelling and upwelling. These measurements provide insight into such properties as chlorophyll concentration, light availability, and reflectance signatures of substrate.
4. Deepwater CTDs (max 500 m), acoustic Doppler current profiler (ADCP), transects around each island/atoll provide information on overall oceanographic structure, including chlorophyll and dissolved oxygen.
5. Continuous recording of surface temperature, salinity, and chlorophyll with the shipboard thermosalinograph and fluorometer.

Long-term oceanographic monitoring is accomplished by deployment and retrieval of a variety of internally recording and near real-time telemetered instrument platforms. These instruments include:

1. Coral Reef Early Warning System (CREWS) Buoys: Surface buoys measuring a number of meteorological (wind speed and direction, air temperature, barometric pressure) and oceanographic (sea surface temperature and salinity) parameters which telemeter data in near-real time.
2. Sea Surface Temperature (SST) Buoys: Surface buoys measuring high resolution water temperature which telemeter data in near-real time.
3. Wave and Tide Recorders (WTRs) measure spectral wave energy, high precision tidal elevation, and subsurface water temperature on the seafloor.
4. Subsurface Temperature Recorders (STRs) measure high resolution subsurface temperature on the seafloor.

5. Aanderaa Current Meters measure high resolution subsurface currents and temperature on the seafloor.
6. Satellite Drifters, Lagrangian devices providing surface layer circulation information and water temperature which telemeter data in near real-time.

Oceanographic operations during the period of February 3-February 26, 2004 on cruise OES-04-02 are summarized in the following tables:

Location	Shallow water CTD casts	Radiometer casts
Ta'u	37	2
Ofu/Olosega	50	5
Rose Atoll	44	-
Swains Island	30	10
Tutuila/Aunu'u	129	24
Total	290	41

Mooring deployments/recoveries					
Instrument type	**Action taken**	**Location**	**Date (UTC)**	**Serial number**	**Depth (m)**
STR	Deploy	S. side, Tau	04-Feb-04	3933179-1151	6.1
STR	Deploy	E. side, Tau	05-Feb-04	3933179-1152	10.1
SST	Deploy	W. side, Tau	06-Feb-04	306-025	13.7
SST	Recover	Tau/Ofu	07-Feb-04	268-003	-
STR	Deploy	REA site Olesega Village	07-Feb-04	3933179-1149	9.8
STR	Deploy	REA site Sili, NW Olesega	07-Feb-04	3933179-1148	6.4
STR	Deploy	REA Site Ofu Village	08-Feb-04	3933179-1150	6.1
CREWS	Recover	W. Lagoon, Rose	08-Feb-04	262-005	8.5
CREWS	Deploy	W. Lagoon, Rose	08-Feb-04	262-004	8.5
Aanderaa	Recover	Atoll Channel, Rose	09-Feb-04	417	3.4
STR	Deploy	W. Lagoon, Rose	10-Feb-04	3933179-1047	3.4
STR	Deploy	W. Lagoon, Rose	10-Feb-04	3933179-1146	7.9
STR	Deploy	REA Site 7-P, wreck site, Rose	11-Feb-04	3933179-1147	7.9
WTR	Deploy	Eastern Reef Slope, Rose	11-Feb-04	2633179-0364	17.1
STR	Deploy	NE. Lagoon, Rose	11-Feb-04	3933179-1145	2.4
ODP	Recover	W. Side, Swains	16-Feb-04	267-001	14.9
STR	Deploy	W. Side, Swains	16-Feb-04	3933179-1142	14.0
SST	Recover	REA Site, Aunu'u	19-Feb-04	268-002	7.6
SST	Deploy	REA Site, Aunu'u	19-Feb-04	306-022	7.6

Mooring deployments/recoveries					
Instrument type	**Action taken**	**Location**	**Date (UTC)**	**Serial number**	**Depth (m)**
STR	Deploy	REA Site Tut-5, Masefau Bay, Tutuila	20-Feb-04	3933179-1143	5.8
SST	Deploy	Fagasa, Tutuila	21-Feb-04	306-023	8.2
STR	Deploy	Airport Lagoon, Tutuila	23-Feb-04	3933179-1141	1.2
Aanderaa	Recover	Steps Point, Tutuila	24-Feb-04	415	22.0
WTR	Deploy	Steps Point, Tutuila	24-Feb-04	2633179-0385	22.0
STR	Deploy	Fagatele Bay (REA site), Tutuila	25-Feb-04	3933179-1144	20.1
STR	Deploy	Fagatele Bay (REA site), Tutuila	25-Feb-04	3933179-1371	6.7
SST	Recover	Amanave, Tutuila	26-Feb-04	268-004	28.0
SST	Deploy	Amanave, Tutuila	26-Feb-04	306-024	28.0

Drifter deployments/recoveries OES-04-02		
Location	**Argos ID**	**Date**
En route to Manu'a from Tutuila	44769	2/3/2004
Manua	44765	2/7/2004
Outside of Rose Atoll	44767	2/8/2004
South side of Swains Island	29109	2/17/2004
SW Tutuila	29110	2/25/2004
NW Tutuila	44770	2/25/2004

Conductivity-temperature-depth (CTD) and Radiometer Casts:

In addition to the above CTD casts, five CTD tows were performed by swimming a SBE19 while collecting GPS track points every five seconds in shallow lagoon areas. Two of these were performed in the lagoon on the south side of Ofu Island, within the boundaries of the American Samoa National Park. These two CTD tows were performed in roughly the same area on February 7 and February 13, respectively, but at different stages of tide: the first near low tide and the second near high tide. Circulation within this lagoon is of special interest because of its high gradient of coral diversity and suggestions of high freshwater inputs. The third tow was performed on the western side of the narrow, extremely shallow lagoon encircling Swains Island. The remaining two CTD tows were performed at Tutuila, in Fagaitua Bay and a lagoon running along the seaward edge of the airport runway, originally part of Pala Lagoon, before being bisected by airport construction in the 1960's. This data has not yet been processed.

The Biospherical™ Profiling Radiometer casts are a new operation to the mooring team. This instrument required extensive preparation and bench testing during the first part of the cruise; the first casts were performed from the deck of the *Sette* on February 12. The first radiometer operations were performed from a small boat on February 13. Data has been successfully collected at each island visited since, with no significant issues with either the instrument itself or the custom deck unit/PC. By February 20, the following protocol for each cast was established:

a. Soak the profiler instrument of the radiometer ~30 seconds to allow its temperature to equilibrate to surrounding water.

b. Position boat so the instrument is up-drift and up-shadow from the boat.

c. Collect >45 sec "dark" reading while instrument is still in the water; pause instrument and remove caps.

d. Wait until motion of the boat is at a minimum and instrument inclination angles are at a minimum; then resume data recording and lower it to the desired depth, at about 0.5 meters/sec.

e. Pull the unit back up at approximately the same rate, pause data collection to replace caps and record a second dark reading (>45 sec.).

f. Record cast time, position, data file name, and any other necessary comments, such as clouds or excessive current.

In almost all cases, radiometer casts were performed immediately following a CTD cast, at intervals of every other or every third CTD cast; so almost all radiometer casts have concurrent CTD information. Two exceptions to this were made at Swains Island, where the radiometer was guided down on top of massive Porites heads.

Mooring Deployments and Recoveries:

STR deployments were generally collocated with selected REA sites. A small subsurface float was attached directly to the reef near the STR location to assist in locating the instrument in the future at most deeper deployment sites. More detailed descriptions of other moorings' deployments and recoveries are below under the area headings.

Ta'u Island (Fig. 1)

SST buoy #268-003 was recovered from National Park Service personnel on Ofu. It had been removed by an unknown party from its original deployment location on the east side of Ta'u in 2002. The original mooring anchor and much of the mooring line was recovered from the original deployment site. An STR was deployed near the old SST location.

The replacement SST Buoy, #306-025, was deployed in 13.7 m of water of the west side of Ta'u just south of Tau Village Harbor at latitude14°14.6229'S, longitude 169°30.5662'W. This deployment site was selected based primarily on recommendations by the *pulenu'u* of Ta'u Village. Members of the mooring team met with the *pulenu'u* (mayor) of the village of Ta'u to ask permission to deploy the mooring, inform him of its

function, and discuss good locations for the replacement SST. This is likely an important step in the deployment of surface moorings in American Samoa; involving or at least informing local villages on mooring deployments will likely increase the longevity of them.

Rose Atoll (Fig. 3)

CREWS Buoy #262-005 (Argos ID 10214) was successfully recovered from its original February 2002 deployment location along with anchor and all associated hardware, including biological settlement plates. It was replaced with new CREWS Buoy #262-004 (Argos ID 27267) at same position, 14°33.0840'S, 168°09.6110'W, in 8.5 m of water. Additionally, two STRs were deployed at 3.4 m and 8 m along the coral pinnacle immediately adjacent to the CREWS buoy to provide a temperature profile.

Aanderaa RCM9 current meter #417 was successfully recovered from its location in 3.4 m of water on the sill of the high velocity pass into Rose Atoll at latitude 14°32.1110'S, longitude168°09.2890'W. This recovery required planning around tidal cycles. Data from the instrument was successfully recovered; data collection ceased around January 26, 2004, probably because of loss of battery power, providing almost 2 complete years of current and temperature data.

WTR #2633179-0364 was deployed in 17 m of water on the easternmost seaward terrace of Rose Atoll, at latitude 168°32.8660'S, longitude 168°8.2564'W. This location is exposed to swells from the north northwest through the southwest.

Swains Island (Fig. 4)

ODP Subsurface Mooring #267-001, deployed at latitude11°3.509'S, longitude 171°5.455'W, was successfully recovered. Instruments appeared in good condition; however, its base was buried in ½ to 1 meter of coral rubble and large coral fragments, indicating a recent extremely high energy event. The settlement plates and racks were extremely damaged, but most were recovered. The Sontek acoustic Doppler profiler current and wave data were successfully recovered, pressure time series complete, as profile data ceased around November 2002; this may be as a result of a downloading error, and the full profile dataset may still be recoverable from instrument. The SBE37 data were successfully recovered, and data collection ceased January 18, 2004 because of low voltage (battery power). Records provided 23 months of temperature and salinity data. The concrete block anchor was left in place, and an STR was deployed on the anchor to maintain temperature time series.

Tutuila/Aunu'u Island (Fig. 5)

SST Buoy #268-002 was successfully recovered from its deployment location at latitude 14°17.023'S, longitude 170°33.737'W in 7.6 m of water off Aunu'u Island. The anchor was on its side, with eye and shackle buried in the sediment; good amount of fouling on both the line and the buoy; otherwise, the instrument appeared in good condition. It was replaced by SST #306-022, with all new mooring hardware.

SST Buoy #268-001 originally deployed in Fagasa Bay, at latitude14°17.057'S, longitude170°43.320'W in February 2002, was no longer there. It was deployed using an eye drilled and cemented into the reef in very shallow water, rather than an anchor in deeper water. After a search, the original drill hole was located. No buoy hardware of

any kind was found. SST #306-023 was deployed in the same vicinity of the 2002 SST deployment, but in deeper water (8.2 m), farther offshore using the standard mooring anchor and line assemblage.

Aanderaa RCM9 current meter #417 was successfully recovered from its location in 22.0 m of water off Steps Point at position 14°32.1110'S, 168°09.2890'W. The instrument was still collected data at the time of recovery and a full 2-year current and temperature time series has been recovered from it.

WTR #2633179-0385 was deployed in exactly the same location as the recovered Aanderaa instrument off Steps Point, providing continuity of temperature data and collecting wave and tide data. This instrument was configured with a 520-day duty cycle, with the hope it can be recovered in approximately 1 year.

SST Buoy #268-002, originally deployed in Fagasa Bay, latitude at 14°17.057'S, longitude 170°43.320'W in February 2002, was no longer there. It was deployed using an eye drilled and cemented into the reef in very shallow water, rather than an anchor in deeper water. After a search, the original drill hole was located. No buoy hardware of any kind was found. SST #306-023 was deployed in the same vicinity of the 2002 SST Deployment, at latitude 14°17. 0615'S, longitude 170°43.3471'W, but in deeper water (8.2 m), farther offshore using the standard mooring anchor and line assemblage.

SST Buoy #268-004, originally deployed in Amanave Bay, at latitude 14°19.6940'S, longitude 170°50.0010'W in February 2002, was no longer there. The original mooring line was parted near the buoy end and was wrapped around several coral heads. The anchor itself was upside down with the mooring line partially wrapped around it and the eye of the anchor buried approximately 1 m deep in sand. All of the existing hardware was recovered and SST Buoy #306-024 was deployed at exactly the same location, in 28 m of water, with all new mooring hardware.

Preliminary Observations

Although most data have not yet been sufficiently processed and checked for quality and biases, some inferences can be made.

For the most part, CTD casts showed surface water temperatures to be ±0.3ºC of the monthly Pathfinder climatology for February. CTD casts at Rose Atoll indicated much higher stratification within the lagoon than outside the lagoon, with an apparent lens of much lower salinity. Also, the casts showed evidence of lower temperature water over the west/center region of the lagoon, apparently associated with heavy rainfall during the data collection period. These trends support the hypothesized convergence in this area, as do observations recorded in 2002 of anomalously high temperature water during different meteorological conditions.

CTD tows conducted through Ofu's Lagoon yielded different data at different tidal stages. The salinities were very uniform throughout the area sampled during the higher tide. Greater differences are apparent in the data collected at a lower tidal stage, with many signs of freshwater input, e.g., distinct areas of relatively lower salinity (33 ppt vs. 35 ppt) and lower temperature (29.5ºC vs. 30ºC). Higher overall temperatures were observed during the higher tide tow, likely due to meteorological conditions (it was

a hotter, sunnier day) than during the lower tide tow. This observation was evident from the lagoon's dependence on prevailing meteorological conditions.

Almost 2 full years of data were recovered from the Aanderaa current meter at Rose Atoll. The overall mean velocity observed from the data is 52 cm/s (approximately 1 knot), with a mean direction flowing out of the lagoon's pass. Maximum recorded outflow is 166 cm/s while maximum inflow is only 50 cm/s. Although patterns of velocity sometimes followed a mixed/diurnal tidal cycle, overall flow was dominated by outflowing currents, with long periods of time (up to weeks) with no observed inflow. This further supports the hypothesized convergence from the CTD data and allows for further supposition that inflow is primarily from gravity wave overtopping and wave setup along the reef crests of the atoll.

Appendix G: **Night Operations and Habitat Mapping Activity Report** (*John Rooney, Megan Moews, Joyce Miller, Scott Ferguson, Bruce Appelgate, and Erin Duribi*)

Night operations conducted from February 3 to 26, 2004, on cruise OES-04-02 included Towed Optical Assessment Device (TOAD) deployments, QTC (benthic acoustic signature) data collection, Acoustic Doppler Current Profiler (ADCP) transects, EK60 bioacoustics lines, and conductivity, temperature and depth (CTD) casts. TOAD deployments were generally conducted between 1830 and midnight to minimize interference with small boat-dependent daytime operations and overhead costs for required shipboard personnel after midnight. These were followed by ADCP transects, bioacoustics lines, and/or CTD casts. When the ADCP was operational at Rose Atoll and the Manua Islands, CTD casts to 500 m were done along ADCP tracks that form a box around the island or atoll; a similar pattern for CTD casts was used at Swains and Tutuila Islands when the ADCP was not functioning. A table summarizing night operations data collected on cruise OES-04-02 follows:

Location	No. TOAD deployments	No. video segments	QTC files	km of ADCP	Hrs of bioac.	CTD casts
Manua Islands	25	25	22	282	0	8
Rose Atoll	0	0	0	157	0	12
Swains Island	0	0	0	0	13	8
Tutuila Island	49	47	57	0	46	8
Total	74	72	79	439	59	36

TOAD deployments at the Manua Islands were challenging because of the steep bathymetry surrounding them, which was also exacerbated by offsets in the charted positions of the islands in the Nobeltec navigation software. Fortunately, the R/V *AHI* was able to conduct multibeam surveys between depths of approximately 20 m and 100 m prior to our operating around Ofu and Olosega Islands. The *AHI* crew provided the ship with screen grabs for areas of particular interest using initial survey results superimposed on more recent charts in which the offset had been corrected. These proved to be particularly useful tools for planning TOAD deployments. Around Ofu and Olosega Islands a shelf, approximately 0.5-1.0 nmi wide between depths of 15-100 m is found in most areas, while Ta'u had almost continuous, extremely steep walls and no banks. At Manua Islands (and Rose Atoll), shallow depths appear to be dominated by encrusting coralline algae, with coral becoming more prominent at deeper depths, which is typical of areas experiencing coral bleaching events. We were also surprised by the lack of fish around the Manua Islands. The benthic topography was often roughly textured, with many holes and overhangs that could provide shelter. In other similar areas we have typically seen increases in fish density. Heavy fishing pressure, particularly from gill nets, has been suggested to explain the relative lack of fish around these islands.

Extensive TOAD operations (49 stations) were accomplished on the broad (1-2 nmi wide) banks with depths between 15-100 m that surround Tutuila Island; the TOAD work was planned to sample areas of varying depths and acoustic complexity that had been identified based upon QTC and depth data collected in 2002. During one tow, slight damage occurred to TOAD, but it was recovered successfully, repaired, and deployed again the same evening. There is also a suspected connector problem in the TOAD video setup with frequent 2-8-second periods during which the video signal is not received; further troubleshooting will be conducted before cruise OES-04-04. During the latter part of cruise OES-04-02 and during the upcoming cruise OES-04-03, the R/V *AHI* is also conducting extensive multibeam mapping around Tutuila; these multibeam data will be combined with the TOAD photographic information and the QTC data to create benthic habitat maps of the area.

The bottom topography around Tutuila is typified by areas of rolling hills and valleys in 15-100-m water depths. Bottom photographs showed extensive areas dominated by large sand fields, interspersed with predominantly *Halimeda sp*. algae beds; these bottom types were expected based upon 2002 photographic and QTC data. The sand beds differed in pattern depending upon the area of the island; in the north and east large sand waves were found; such sand waves are indicative of strong wave action that is associated with the prevailing easterly trade winds. However, in the west and southwest, sand bed forms included large areas dominated by mounds and craters usually associated with bioturbation, very small wavelength sand bed forms suggesting a low energy environment, and scoured areas with large grained sand and shell hash. There are isolated shoal areas of less than 20-m depths on all sides of Tutuila, except in the central southern part near the airport, which drops off steeply. These scattered, coral-rich areas were found, generally in mounds that rise to depths of 25 m or less; however, in one area in the northeast a small, rich *Montipora* coral bed was seen in 60+ m water depths. A few small areas of dense sea fans were found near steep banks on the southern side of the island. During many of the TOAD tows small shrimp, fish, and krill were so dense that it was at times difficult to see the bottom from a meter or less distance; concurrent bioacoustics records also indicate a dense biomass in the water column.

At Rose Atoll and Swains Island, there were no areas that were shallow enough to safely deploy the TOAD. Night operations were therefore limited to CTD casts and ADCP lines at Rose and CTD casts and EK60 bioacoustics lines at Swains. A drifter buoy was deployed southeast of Rose, another deployed 6 km southwest of Ta'u Island, a third released between Tutuila and the Manua Islands, a fourth released south of Swains Island, and two more drifters released at the CTD stations south and west of Tutuila.

All ADCP data collected during this leg is unfortunately suspect. There appear to be shorts in the ADCP, in the cabling, or within the transducer itself. Some of the data may be recoverable. We also had continued problems with the CTD winch. The Senior Survey Tech, Phil White and Electronics Technician, John Skinner, put together and re-terminated a different CTD which was deployed from a winch above the longline pit.

Eight CTD casts were conducted around the Manua Islands, 12 around Rose Atoll, 8 around Swains Island, and 8 around Tutuila Island. Two CTD's to 100 meters were conducted at Ofu and Olosega immediately after radiometer casts. CTD profiles around the Manua Group were characterized in general by chlorophyll maximums that coincided with temperature decreases, salinity increases, and dissolved oxygen decreases

at approximately 100 meters. CTD profiles at Rose Atoll differed from the Manua Group profiles in that the temperature profile suggested a mixed layer to a depth of approximately 40 m, followed by a gradual and linear decline in temperature with increasing depth, with no distinct thermocline. Profiles from the fluorometer, dissolved oxygen, and salinity sensors showed that the chlorophyll maximum occurred along with a salinity increase and a drop in dissolved oxygen at approximately 150 meters rather than a distinct thermocline. At Swains Island CTD casts showed a consistent pattern with the mixed layer ending sharply between 40 and 60 m and a gradual thermocline to 500+ m. The chlorophyll maximum is tied to the base of the mixed layer and a salinity increase, rather than to a steep thermocline as might be expected. Tutuila CTD casts generally showed no distinct mixed layer with a gradual thermocline to 500+ m.

EK60 bioacoustics lines were set up near Swains and Tutuila Islands, generally between 2:00 a.m. and 6:00 a.m. (local). At Swains, bioacoustics data were collected in three concentric circles around the island, with one circle at ~1000 fm deep between CTD stations, a second circle near the 500-fm contour, and a third ~0.4 nmi from the edge of the reef. Around Tutuila four replicate bioacoustics lines (NE, NW, SE and SW) were run between TOAD waypoints approximately 5 nmi apart and one stationary bioacoustics station was completed at TOAD site TUT068.

Multibeam Benthic Habitat Mapping Aboard the R/V *AHI* (Scott Ferguson, Bruce Appelgate, Joyce Miller, John Rooney, Megan Moews, Michael Parke, Erin Diurba, and Hans Van Tilberg)

Multibeam mapping was conducted in American Samoa during cruises OES-04-02 and OES-04-03. During the first 2 weeks of operations, the banks and near-shore areas of the Manu'a island group were completely mapped in depths between 20 and 250 meters, after which operations moved to Tutuila. During 4 weeks of operations there, the entire southern half of Tutuila was mapped to similar depths, including Pago Pago Harbor, Fagatele, Larsen, and Leone Bays. Taema and Nafanua banks and the extensive bank east of Tutuila and Aunu'u Island were also completely surveyed.

The R/V *AHI* (Acoustic Habitat Investigator) was off-loaded from the NOAA ship *Oscar E. Sette* in Pago Pago Harbor on Friday, January 30, 2004, and it transited from Pago Pago to Ofu Harbor in tandem with the *Sette* on February 3, 2004. Diesel fuel for the *AHI* operations was delivered to Ofu by the M/V *Manu'atele II* on February 4, and multibeam survey operations began that afternoon. The R/V *AHI* returned to Tutuila Island in tandem with the *Sette* on Saturday, February 14, 2004. After a short maintenance period, the *AHI* began surveying off Tutuila and Aunu'u Islands. These operations continued after the end of cruise OES-04-02 while the *Sette* conducted pelagic investigations during cruise OES-04-03. On March 17, the multibeam mapping operations ceased when the R/V *AHI* was loaded back onboard the *Sette.*

Daily operations included an initial CTD cast using a SeaBird SeaCat CTD. Multibeam surveys were conducted using the *AHI's* 240 kHz Reson 8101ER multibeam sonar coupled with a POS/MV GPS-aided inertial navigation and motion sensor. Real-time corrections were made for all ship motion and predicted tides, and the sound velocity profiles derived from the CTD casts were entered daily. Observation during

real-time operations showed few offsets in the data, indicating no known problems with motion correction, sound velocity, and predicted tide corrections.

In the Manu'a Islands, approximately 55 hours of multibeam surveys were conducted in water depths ranging from ~5 to 300+ meters. Approximately 24 sq. nmi of seafloor were surveyed, resulting in a survey efficiency rate of 0.44 sq. nmi/hr in Manu'a. In Tutuila, 148 hours of survey were conducted, covering approximately 55 sq. nmi of seabed. This yields a survey rate of 0.37 sq. nmi/hr off Tutuila. The difference in survey rate reflects the fact that Tutuila has much larger banks than the Manu'a Islands and a longer coastline, thus more time was spent surveying in relatively shallow waters and transiting to survey sites.

Areas of particular interest in Manu'a were thoroughly surveyed to depths as shallow as 5 meters; these areas include the National Park of American Samoa on the south shore of Ofu Island and the southwest end of the air strip on Ofu that is being evaluated for runway extension. All areas were surveyed to a depth of at least 200 m and coverage to 300 m was possible in many areas. In addition to Ofu, Olosega, and Ta'u Islands, a submerged volcanic ridge between Olosega and Ta'u was surveyed in depths of 40 to 300 m. Existing nautical charts (NOAA Chart 83484) for Ofu, Olosega, and Ta'u include very little information about water depths less than 100 fm; therefore, initial survey lines around each island were conservatively run in 50-100-m water depths to establish a baseline. In some cases, as few as three lines were needed to map between 20 and 250 m because of the steep slope around Ta'u in particular. Ofu and Olosega proved to have broader shoulder areas between 5 and 100 meters, and an average of 6 passes was needed to map these islands down to an average of 250 m.

In Tutuila, only the area off the airport and Viatogi have a steep shelf and the majority of the survey was spent characterizing the island's extensive banks that range in depths from 20 to 60 meters. Pago Pago Harbor was mapped, as were the areas offshore of the villages of Utulei, Fagaluu, and Aua. Both the inner and outer harbor areas are dominated by flat areas of low acoustic reflectivity, which is typical of mud and sand. It appears that Taema Bank acts as a dam to capture much of the sediment that is deposited in the harbor during times of heavy rainfall. This interpretation is reinforced by the fact that the inner portion of Taema Bank has areas with extensive sand or mud waves, while the outer portion is highly reflective and appears to consist of hard seabed. All of the seaward portions of Taifuna Plain were mapped including the banks near Nuuuli, Vaitogi, and Leone. The Fagatele Bay National Marine Sanctuary was mapped, with particular emphasis on defining the morphology of the seaward portion of the canyon that originates in the Sanctuary. Larsen Bay, which is immediately adjacent to Fagatele Bay, was mapped in a similar fashion, thus defining the seaward portion of this unique area.

The large bank east of Tutuila was completely mapped, including a ridge that extends east from Aunu'u Island and then runs north along the seaward edge of the bank. Portions of the bank south and west of Leone were also mapped. All of these banks appear to be dominated by a ridge that runs along the bank edge. The ridge top, which varies from less than 10 meters (west of Aunu'u) to as deep as 40 meters in the northeast, is rough and highly variable and may be rich in coral. Inside of this ridge the seabed is largely uniform in nature with some flat areas of low acoustic reflectivity that appear to be sediment ponds. The majority of the survey effort was spent on the south side of the island, where the majority of the population resides and human impacts are greatest.

However, some surveys were conducted north of Tutuila when weather precluded operating in the south. Two days of operations in the north resulted in surveys off the villages of Fagamalo and Aoa and a minimum of two survey lines in 20-60-m depths around the entire northern side of the island.

Preliminary bathymetry processing and data cleaning were completed for about 75% of the data collected. This effort will continue in Honolulu. Bathymetric processing was accelerated for several specific areas that were identified by local agencies as being of particular interest. For these areas, preliminary data products were delivered to NOAA representatives Fatima Sauafea and Nancy Daschbach for distribution to other local agencies. These areas included Fagatele and Larsen Bays and the steep shelf off the airport, which is a candidate site for an Ocean Thermal Energy Conversion (OTEC) installation; the channel between Aunu'u and Tutuila. which is being considered for a new electrical cable installation; and the wreck of the USS *Chehalis* near the fuel pier in Pago Pago Harbor.